Koen Smet

The reintegration of the South African economy into the global economy and its influence on (un)employment in the post-apartheid era

Thesis

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Acknowledgements

The reason why this thesis concentrates on the link between trade and employment in South Africa is the result of two general observations I made while writing my master's thesis. The subject of my master's thesis was the link between economic policy and trade performance. In this thesis I compared South Africa with Malaysia. One of the observations I made was that the South African trade structure appeared to be specialised on the export of natural resources and minerals, whereas it imported a broad variety of goods. Simultaneously, South Africa was confronted with high rates of unemployment, but I could not elaborate on this topic in my master's thesis. Therefore, when I became the opportunity to write a doctoral thesis it was rather clear that I wanted to analyse a possible link between trade and labour market effects.

I wrote my doctoral thesis as part of my four-year teaching and research assistant's post at the Institute for International Economics and Development of the WU Vienna. Therefore, I would like to thank both Ingrid Kubin and Joachim Becker for offering me this post in January 2007 and for supporting my research during this time period. Moreover, I would like to thank all my colleagues and former colleagues of this institute. They were not only a great source of help and encouragement for my research, but they were also always available for general discussions on economics. Another field in which I could learn a lot from them was teaching. Once again, it were the discussions we had that made me reflect on my own teaching style and that made me continually improve my teaching skills. Also the secretaries of the institute were of great help for administrative and personal support. In addition, I would like to thank all the participants of the Economics Department's Staff Seminars. This platform offers a great possibility to present work in progress and to interact with colleagues.

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Introduction

South Africa is a most interesting country to examine in the context of trade policy and trade performance. Its long history of apartheid created a society of abundant unskilled labour and a semi-industrialised economy. Therefore, South Africa can neither be classified as a typical developing country nor as an industrialised country. Furthermore, since transition to multi-racial democracy in 1994 the government has pursued a rather liberal trade policy. It was one of the founding members of the World Trade Organisation and is engaged with the European Union in the Trade, Development and Cooperation Agreement. At the same time, domestic unemployment rates increased sharply to more than 30%, causing a major social and economic problem. These observations raise the research question of this thesis: How did the reintegration of South Africa in the world economy influence domestic employment?

To answer this question one first needs a thorough understanding of the South African trade pattern, because trade liberalisation can have different implications on an economy. In general, the theory of international trade shows that trade liberalisation results in a higher degree of trade openness, due to increasing imports and exports. On the industry level, however, it is not clear what will happen. One possibility is that industries with a comparative advantage will export more, whereas imports in industries which face a comparative disadvantage will increase and production will decrease. In this case trade structure is characterised by specialisation, i.e. inter-industry trade exists. Theoretic models that describe and explain this phenomenon are the Ricardian and Heckscher-Ohlin-Samuelson trade models. According to these models trade occurs due to different comparative advantages. Trade liberalisation can, however, have another impact. Imports and exports within the same industries could increase simultaneously. This is described by the term intra-industry trade. The theoretic explanation of this situation is based on monopolistic competition between firms, e.g. Krugman (1980) and

Melitz (2003). If thus trade liberalisation results in an inter-industry trade pattern for South Africa the pains and gains of reintegration will be divided amongst different industries, whereas an intra-industry trade pattern indicates that adjustments will take place within industries.

Taking into account this fundamental difference Chapter 1 of this thesis offers a descriptive analysis of the South African trade pattern. Whereas both Isemonger (2000) and Parr (2000) offer interesting insight, they do not cover the entire spectrum of the South African trade pattern. The former paper estimates intra-industry trade in South Africa and comes to the conclusion that the level of intra-industry trade is rather low. The latter paper analyses the trade specialisation that occurred in South African industries between 1993 and 1998. Over time only a small fraction of manufacturing industries could improve their trade balances, whereas the lion's share of industries faced increased competition. To get, however, a more profound knowledge of the South African trade structure a combination of both approaches for a longer time period is essential. Moreover, the approach can be used to differentiate between different trading partners, i.e. industrialised economies, emerging countries and African neighbours. These three categories will be approximated by using the South African trade data with the European Union (EU), China and the Southern African Development Community (SADC). In addition, the results of this descriptive analysis can be combined with production data to yield extra information concerning the production structure of different industries. The results show that the South African trade structure is best described as inter-industry trade. In a next step, this insight can be used to develop a theoretical trade model that explains international trade by means of differing factor endowments.

Modelling the impact of the South African trade pattern on employment introduces two theoretical challenges. The first challenge is related to the dimensionality of the trade model, whereas the second challenge concerns labour market effects. With respect to the dimensions of the trade model it should be noted that the results of the descriptive analysis indicate that the trade model has to include three different production factors as well as three different product classes. Furthermore, to simplify reality and to establish a symmetric trade model this thesis neglects the trade relation between South Africa and the SADC on a theoretical level. Thus, only trade flows between the three trading partners, i.e. South Africa, the EU and China, will be considered and

modelled. Whereas a standard Heckscher-Ohlin-Samuelson trade model explains international trade based upon the different factor endowment of trading partners, this model considers only two dimensions, i.e. either capital and labour or skilled and less-skilled labour are considered as production factors. Therefore, this trade model can be used to model South African trade, but should be extended with a third dimension. With respect to a multi-dimensional version of this model academic discussion focussed mainly on the generalisation of the price equalisation theorem, the Heckscher-Ohlin theorem, the Samuelson-Stolper theorem and the Rybczynski theorem, e.g. Samuelson (1953), Chipman (1966, 1969), Batra and Casas (1976), Jones and Scheinkman (1977), Chang (1979), Takayama (1981) and Ethier (2003). These papers remain, however, very general and are not explicitly deployed to the specific problem of this thesis, i.e. a three-dimensional trade model. One major problem in such a multi-dimensional trade model is the notion of factor intensity which is discussed by Jones and Scheinkman (1977). One possibility to overcome general modelling constraints offers the concept of the endowment triangle and the triangles of diversification. The concept was developed by McKenzie (1955) and discussed and applied by Leamer (1987), Jones and Marjit (1991) and Jones (1992). Taking into account the complexity of this problem Chapter 2 is dedicated to tackle this problem and construct a three-dimensional Heckscher-Ohlin trade model which does not consider any employment effects.

With respect to the second challenge it is worth mentioning that the impact of international trade on employment has long been a blind spot in the theory of international trade. Almost all theoretical models assume factor full employment, i.e. wages adjust to market clearing conditions and as a consequence unemployment is unknown within the model. The political debate on international trade, however, revolves around the impact of international trade on domestic employment. One of the first theoretic papers dealing with this topic was Brecher (1974). The paper extends the Heckscher-Ohlin-Samuelson model by introducing a binding minimum wage. Within a stylised two-dimensional world, i.e. two production factors, two industries and two countries, this minimum wage corresponds to a specific relative equilibrium price. Although various production levels with different levels of unemployment correspond to this equilibrium price, all these levels guarantee production equilibrium. As a result the paper shows that under specific conditions free trade increases the unemployment level of a country. Krugman (1995) applies

a similar concept on two stylised country groups representing OECD countries and Newly Industrialised Economies (NIE). Whereas Brecher (1974) uses capital and labour as production factors, Krugman (1995) uses skilled and unskilled labour as production factors. To analyse the effect of international trade on the European labour market fixed relative wages and full employment of the skilled labour force in the OECD countries are assumed. The main finding of the model is that a fall in the relative demand for the unskilled intensive good reduces employment of unskilled labour. Moreover, unskilled intensive imports from the NIE group into the OECD group cause an increase of unemployment of unskilled labour, which is partly caused by direct import effects and which is partly due to a fall in domestic income and hence domestic demand. This stylised approach was extended by Davis (1998), which explores the consequences of trade between a flexible wage country (e.g. America), a rigid wage country (e.g. Europe) and a 'South', where unskilled labour is relatively abundant. Within this three-country model the European labour market is put further under pressure. The technique to model unemployed developed in these three papers and the insights gathered by these papers are used in Chapter 3 of this thesis to extend the theoretical three-dimensional trade model with employment effects. This chapter also includes a descriptive analysis of the South African labour market since the end of the apartheid era. The use of a binding minimum wage to model labour market rigidity in the trade model is supported by the insights of this analysis. This results in a three-dimensional Heckscher-Ohlin trade model that allows to evaluate the impact of economic reintegration on the South African labour market on a theoretical level.

The last chapter of this thesis, Chapter 4, is an econometric analysis of the impact of trade on employment to test the predictions of the three-dimensional model. Whereas the academic discussion recognises the fact that trade can have a negative effect on employment, most empiric studies on South Africa display, however, a small positive effect of trade on employment (e.g. Edwards, 2001, Edwards and Behar, 2005). Commonly technological change is highlighted as the main source of employment loss in these studies (e.g. Edwards, 2001, Jenkins, 2008). The general problem of these studies is that they do not use a trade framework to analyse the impact of trade on employment. Therefore, this thesis can extend the discussion by offering econometric specifications which are conform to a trade model. Moreover, trade liberalisation will probably have a positive effect on employment opportunities for skilled labour, whereas

its effect will be negative for less-skilled labour. The distinction between these two types of labour as well as capital is part of the empirical model and is explicitly considered in the empirical estimations of this thesis. Both the results of the empirical and the theoretical analysis can be used to not only assess the impact of trade liberalisation on the South African labour market, but also to understand the link between these two macroeconomic variables.

The thesis contributes to the South African discussion on causes of unemployment. Its main strength lies in the use of an international trade framework, which is a unique focus in the debate. It shows in a differentiated way how South African trade performance influenced labour market outcomes since 1994. The results of this exercise can further be applied to formulate policy recommendations for the future. Besides its contribution to the specific South African situation, the thesis also contributes to the theoretical debate on the employment effects of international trade. Due to modelling limitations, especially within the Heckscher-Ohlin-Samuelson trade theory, this topic has long been neglected by scholars. Moreover, it applies the literature on multi-dimensional trade models explicitly to a three-dimensional Heckscher-Ohlin-Samuelson trade model. The combination of the three-dimensions with labour market rigidities in a trade framework shed new light on the possible impact of trade an unemployment.

Chapter 1

Stuck in the Middle?

1.1 Introduction

After the end of the apartheid era the new government actively pursued to integrate South Africa's economy into the global economy. One of the policy measures at hand to achieve this goal was trade policy. In general, a trade policy which aims at global economic integration will increase the trade openness of the economy. By means of different measures both export and import flows are increased resulting in a higher degree of trade openness. This trade openness can, however, result in either inter- or intra-industry trade. This in turn will affect the adjustment cost and the gains induced by trade liberalisation. Therefore it is important to analyse the South African trade pattern and its evolution between 1993 and 2006.

Besides the trade relation between South Africa and the world, some trading partners are given extra attention in order to accentuate the special position of South Africa. This is mainly due to the fact that as a semi-industrialised nation it can neither be classified as a typical developing economy nor as an industrialised country. Due to this differentiation the hypothesis can be tested that South Africa holds a middle position between its industrialised trading partners and emerging developing countries on the one hand and its African neighbours on the other.

The analysis consists of a comprehensive approach which bases upon Isemonger (2000) and Parr (2000). In contrast to these studies the approach developed in this thesis does not focus on one specific measure, but combines an intra-industry indicator, an indicator to measure specialisation and a measure of revealed comparative advantage. By combining these

measures it is thus possible to comment in detail on the evolution of the South African trade structure.

The chapter starts with a discussion of the South African trade policy since the 1990s. This section also elaborates on the extent of trade liberalisation caused by this policy. The following section outlines the trends within trade flows between 1993 and 2006. Besides general observations concerning the export and import flows, differences between trading partners are discussed. Furthermore, a distinction is made between evolutions on a general level and changes on industry levels. The next section deals intensively with the notion of intra-industry trade. It elaborates on the definition of intra-industry trade and on its measurement. Estimations concerning intra-industry levels are given for trade on a world level as well as trade with different trading partners. The intra-industry measure is combined with a revealed comparative advantage measure in the following section. This allows to assess different trading positions on industry levels. Subsequently, a marginal intra-industry trade index is discussed and added to the previous measures to establish an analysis and classification tool. As will be shown this technique allows a detailed evaluation of the change of trade flows over time. In the last section the analysis results are linked to the sectoral production structure. Here a distinction is made between productive capital, skilled labour and less-skilled labour. The conclusion at the end of this chapter summarises its main findings.

1.2 Trade Policy: Liberalisation?

One of the main questions that was fiercely discussed amongst South African scholars is the question to what extend the trade policy of the new South African government induced trade liberalisation since 1994. This was a legitimate question since the ANC-led government was active in different international fora to negotiate trade liberalisation on a global or regional level. The diversity of this makes it difficult to assess the impact of trade policy. Moreover, most trade agreements foresaw a gradual implementation and do not only include nominal tariff rates. Before taking a closer look at trade liberalisation, this section introduces three main institutions which are relevant to understand the South African trade policy.

The first international institution that has a significant impact on the South African trade policy in the post-apartheid era is the World Trade Organisation (WTO). The WTO is the result of the Uruguay Round, which proceeded from 1986 until 1994. Although 123 countries were involved, negotiations were dominated by the transatlantic countries, i.e. the USA and the EU. (Becker and Blaas, 2007) The Uruguay Round was completed by the signing of the Marrakesh Agreement which constructed the legal base of the WTO. (WTO, 2008) Although multiple agreements were signed the most important agreements were the General Agreement on Tariffs and Trade (GATT 1994), the General Agreement on Trade in Services (GATS) and the Agreement on Trade-Related Investment Measures (TRIM). (WTO, 2008) As explained by Hirsch (2005) South Africa was involved in these negotiations by means of the National Economic Forum (NEF). The NEF was a tri-party negotiating body in which labour, business and government (including the ANC) were represented. This was necessary because the beginning of the 1990s was characterised by a high degree of political instability in South Africa. Within the WTO framework the South African trade policy foresaw the introduction of a cascading tariff structure in which raw materials did not enjoy any protection, capital goods and intermediates were subject to a tax ranging from 10% to 15%, and for consumer goods taxation between 20% and 30% were due. (Hirsch, 2005)

In the wake of the transition to democracy South Africa joined the Southern African Development Community (SADC). Moreover, South Africa was also member of the Southern African Customs Union (SACU). These multinational organisations are characterised by a high degree of diversity between its members. Whereas Botswana and South Africa are upper-middle-income countries, other countries such as Lesotho, Angola and Mozambique are least-developed countries according to the UN (2009). Due to the fact that South Africa is the largest economy in both organisations, it is not surprising that it has a dominant economic position in these organisations. With respect to trade policy it should be mentioned that the original vision of balanced trade between SADC members is substituted for the vision of a free trade area. (Wellmer, 2007)

The last trade institution is the Trade, Development and Cooperation Agreement (TDCA). This agreement was signed on 11 October 1999 between South Africa and the EU. This bilateral agreement cannot be regarded as a mere trade deal since it covers also other topics. In the words

of the European Union (2008): "*The agreement establishes an ongoing* ***political dialogue*** *on subjects of common interests, both at bilateral and regional level (in the context of the EU's dialogue with the countries of southern Africa and the African, Caribbean and Pacific (ACP) countries).*" In this treaty, the EU grants 95% of South Africa's production a better market access within ten years, whereas South Africa facilitates the market access of 86% of European imports until 2012. Although the agreement grants South African products a short preferential access to the European markets, the agreement envisages a progressive introduction of a free trade area. (European Community, 1999, European Union, 2008, Wellmer, 2007)

One of the first papers that assesses the extent of trade liberalisation in the 1990s was Fedderke and Vaze (2001). Due to data limitations the authors have to ignore non-tariff trade barriers and focus on tariff-based protection. Moreover, the use of nominal tariff rates, calculated on a sectoral level as the share of paid duties on imports relative to the value of these imports, induces a major problem. As noted by Fedderke and Vaze (2001, 442) this approach would ignore differences between effective protection, i.e. protection with respect to the value added. Therefore, the authors distinguish between finished goods and intermediates and use the concept of the effective rate of protection (ERP) to discuss trade liberalisation. They calculate the ERP by means of the difference between the tariff level for final goods and the tariff level for intermediates adjusted by the input-output coefficient. Based on their results they conclude that trade liberalisation in South Africa for the 1988-98 period was partial or incomplete, since besides decreases in some sectors their evidence shows also that the ERP remained constant or increased in other sectors.

The results of Fedderke and Vaze (2001) were, however, contested by Rangasamy and Harmse (2003). Their main argument is that the ERP measure used by Fedderke and Vaze (2001) does not account for the relative importance of the different sectors in the South African economy and trade balance. To overcome this shortcoming they include relative output data for the different industries. According to Rangasamy and Harmse (2003) their results suggest that trade liberalisation did happen in South Africa. i.e. at the end of the 1990s a higher share of South African output was liberalised than protected. The work of Rangasamy and Harmse (2003) evoked in turn the response of Fedderke and Vaze (2004). Besides pointing out some shortcomings of the methodology and

the interpretation of Rangasamy and Harmse (2003), they welcome this debate. However, they stick to their original interpretation.

The debate ended with the paper of Edwards (2005) which analysed the cause of differences between previous studies and offered an extensive independent analysis. One main finding of the analysis is the decrease of both scheduled and collected nominal tariff rates between 1990 and 2004. Not withstanding the fact that in all sectors a decline of nominal tariff rates was observed, sectoral differences are worth mentioning. Whereas the percentage points decline in *beverages (-9.5)*, *textiles (-17.5)*, *footwear (-17.2)*, *wearing apparel (-25.2)* and *communication equipment (-17.2)* industries was large, this decline was rather small in the *wood products (-5.3)*, *paper products (-4.5)*, *basic chemicals (-6.1)* and *basic iron and steel (-4.7)* industries. In some industries, e.g. *wearing apparel*, *tobacco* and *footwear*, the scheduled tariff rates remained high despite nominal tariff reductions. In view of these results the author remains critical and remarks that although the tariff structure was simplified, there remains further scope for simplification. For example, in 2004 the number of tariff rate lines was still 38, although South Africa proposed the use of only six lines within the WTO framework. Moreover, the effective protection is also considered in Edwards (2005), since nominal tariff rates neither consider the impact of tariffs on the production process nor account for incentives. This measure shows also that the effective protection of the South African economy was reduced. A common view of the South African trade policy is that it was anti-export biased. With respect to this bias, the ERP measure suggests that there was only a marginal improvement between 1994 and 2004. This indicates that the trade regime is still unfavourable to exports. Furthermore, the critique of Holden (2005), which makes some fundamental remarks on the use of the ERP, should also be considered. The general conclusion of this section is that in the period 1990-2004 trade liberalisation occurred and that trade distortion due to tariffs decreased.

1.3 Broad Trends between 1993 and 2006

Before starting to discuss the evolution of trade data the used data sets should be discussed. The first data set consists of trade data on both the 4-digit and the 6-digit Harmonised System classification, which were made available on the website of the Trade & Industrial Policy Strategies (2009). Concerning the trading partners the EU aggregate refers to the

27 EU member states[1] and the SADC aggregate refers to 13 countries[2]. The second data set contains GDP data and comes from Statistics South Africa (2009). Since different quarterly data were available, the use of GDP at market prices and at current prices is justified by the assumption that trade data are also at market prices. The difference with total value added at basic prices is, however, minimal and consists of taxes and subsidies. These two data sets can be combined to calculate export and import shares[3] on product levels.

The aim of this section is to describe the South African trade pattern thoroughly. Whereas a general analysis of trade shares neglects differences on industry levels and differences between different trading partners, this differentiation is also made in this section. Therefore, the approach developed in this section covers different fields of interest with respect to trade. Besides an overall description of the evolution of trade shares this section elaborates on differences between three trading partners. Moreover, detailed information at product line and industry level is highlighted. In a last step these two disaggregations are combined to bring out differences between the trading partners at product line levels, which can be linked to different factor intensities on industry levels.

Figure 1.1 visualises the evolution of the South African export and import share between 1993 and 2006. Over the entire period the export share grew on average with 2.01% per annum. The average annual growth rate of the import share was 5.03%. Therefore, it should not come as a surprise that the initial trade surplus turned into a trade deficit. Whereas in 1993 the import share lay well below the export share, 14.11% and 17.58% respectively, in 2006 the import share reached a value of 26.71%, almost four percentage points above the export share. This change, however, did not happen gradually, as can be seen from the curves in Figure 1.1. The drop of both shares in 2003 is highly remarkable and can probably be attributed to the strong appreciation of the rand. Whereas the

[1] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

[2] Angola, Botswana, Democratic Republic of the Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Swaziland, Tanzania, Zambia, Zimbabwe

[3] Export shares are the ratio of exports to GDP, import shares are the ratio of imports to GDP. These values are used since they capture the change of trade flows relative to economic output.

exchange rate in 2002 was 1051.65 SA cent per USA dollar, this value dropped to 756.47 in 2003 (South African Reserve Bank, 2009). Following this appreciation the trade balance turned negative. A similar observation was also made by Petersson (2005). In general, it can be claimed that according to Figure 1.1 the South African economy became more integrated in the world economy during this period.

Figure 1.1: Export and import shares 1993-2006

Besides the overall trade pattern it is also interesting to take a closer look at the trade structure with specific trading partners. In the case of South Africa it is necessary to analyse the trade pattern with the SADC, the EU and China separately. First, the EU is South Africa's single most important trading partner with respect to trade shares. Between 1993 and 2006 the share of South African exports destined for the European market increased from 22.60% to 31.83%. The share of South African imports originating from the European market decreased in the same period from 41.87% to 34.65%. Despite this decrease European imports remained important. The export share grew on average by 4.74% per annum, whereas the import share grew on average by 3.52% per annum. Notwithstanding this fact, over the whole period the trade balance between South Africa and the EU was in favour of the latter. Moreover, the EU is an industrialised economic region and can be used as proxy for

trade with developed countries. In this analysis the EU is, although historically not correct, defined as the 27 EU member states. Second, China is an emerging economy that significantly influenced international trade flows since the 1990s. Moreover, it is not a typical developing country and is richly endowed with labour. The emergence of China as a trading power is also displayed by the data. Whereas in 1993 less than 1% of all exports went into China, in 2006 this figure was already 3.54%. The export share had an average annual growth rate of 13.80%. The average annual growth rate of the import share was even higher at 20.52%. Thus, it is not surprising that in 2006 around 10% of all imports had Chinese origins in comparison with only 1.68% in 1993. Third, the inclusion of the SADC is relevant since trade between South Africa and the SADC produced a consistent trade surplus for South Africa. This trade surplus compensated roughly the trade deficit with both the EU and China. Although the average annual growth rate of the export share was 2.02% and well below the average annual growth rate of the import share of 7.21%, the share of SADC exports and SADC imports was rather constant at about 9% and 2% respectively. By considering these different trade patterns, more insight in South Africa's trade structure can be generated.

At this point it is necessary to compare the results with other literature. Although the regional export and import shares are similar to those found by Petersson (2002, 2005), the difference between average growth rates is in need of an explanation. Petersson (2002) mentions average export and import growth rates of respectively 19.9% and 13.6% for the period 1994-1999, which is much higher than the average annual growth rates mentioned above. This difference is, however, due to the fact that Petersson (2002) calculates the growth rate of export and import levels in contrast to trade shares used above. Based upon the data used in this study the average growth rate of exports and imports for the period 1994-1999 are 12.89% and 13.84%, respectively. Since calculations based upon level data do not consider economic growth, i.e. GDP growth, it makes more sense to use trade shares. Otherwise it remains unclear to what extend trade changed relative to the size of the domestic economy. Petersson (2005) calculates an average growth rate of exports of 4.5% for the period 1992-2001, a value closer to those mentioned above. All in all the basic results are thus supported by other findings.

Another disaggregation that should be considered is the industry level and the product line data. The industry aggregates are based upon the

South African Standard Industry Classification, which comprises 35 industries that produce tradable products. A list of these industries can be found in Appendix A (p. 101). By means of a list of concordance between the Harmonised System (HS) 6-digit classification and this industry classification trade data are available at industry levels. This approach offers the opportunity to link factor intensities with the trade pattern. The used level of product aggregation is based on the considerations of Grubel and Lloyd (1971), Isemonger (2000) and Parr (2000). These authors argue that it is impossible to uniquely define the correct level of aggregation. This is due to the fact that the classification of products cannot correspond completely with industries and that the definition of an industry is arbitrary. Therefore, following Isemonger (2000) and Parr (2000), the analysis uses the HS 4-digit classification with respect to the product level. Doing likewise, makes the results of the analysis comparable with these studies. As a result of this approach the analysis considers 1811 product lines and 35 industries. Due to the discrepance between the used classifications, some HS 4-digit product lines are divided among different industry aggregates.

Between 1993 and 2006 exports were mainly dominated by mineral and mining industries. Combined these industries generated around 40% to 50% of total export value (see Appendix B.1). This figure consists of the *basic iron and steel*, the *basic non-ferrous metals*, the *coal mining* as well as the *other mining* industry aggregates which contribute respectively about 10%, 20%, 5% and 10%. The main products exported by these industries are ferro-alloys, flat rolled products of iron, non-alloysteel or stainless steel, coal, iron, titanium, aluminium, gold, platinum and diamonds. Simultaneously, the share in total exports of the *machinery and equipment* and the *motor vehicles, parts and accessories* industry aggregates increased steadily in the same period and were both just below 10% in 2006. The exports of these industries were mainly motor vehicles, parts and accessories of motor vehicles and centrifuges. Thus exports comprised products which are affected by the Motor Industry Development Programme (MIDP). Notwithstanding this evolution, South Africa was and, indeed, still is an exporter of natural resources, especially minerals and metals.

The above observed export pattern can also roughly be used to describe the export pattern with the EU and China (see Appendix B.2). Exports from South Africa to the EU include besides minerals, metals and prod-

ucts from the auto industry also fruit (e.g. citrus fruit, apple, pears and grapes). Therefore, the trade pattern with the EU is slightly more diversified than the overall pattern. The export pattern to China on the other hand is more concentrated. Within this trade relation products from the *basic non-ferrous metals* industry aggregate (i.e. gold, platinum and aluminium) are not dominating. Exports to China are rather concentrated on iron, products of iron and non-alloy steel and ferro-alloys. The structure of exports from South Africa to the SADC is, however, remarkably different from the overall trade pattern (see Appendix B.2). Exports are diverse and not concentrated on natural resources. Besides products of the *basic chemicals* (e.g. fertilisers), the *other chemicals and man-made fibres* (e.g. soap) and the *machinery and equipment* industry aggregates (e.g. parts and accessories for office machines) also non-crude petroleum oils, food, motor vehicles and paper products (incl. newsprint) account for a significant share of exports. The difference between the overall trade pattern and the structure of exports to the SADC is thus considerable.

Thus far, one of the main conclusions of Petersson (2005), a declining dominance of primary and resource based industries, is not shared by this analysis. The above analysis only finds a trend of declining export concentration within the *other mining* industry aggregate. This trend is, however, not observable within the other primary and resource based industry aggregates. Moreover, a trend of increasing export concentration within the *motor vehicles, parts and accessories* is noticeable. Furthermore, the export pattern with respect to both the EU and China is remarkably different from the export pattern to the SADC. Therefore, based upon this analysis it cannot be claimed that a trend of convergence between the trading partners is visible.

In the same period around half of total imports were due to five industry aggregates (see Appendix C.1). The share of the *machinery and equipment* aggregate was the highest and was around 18% of total imports, whereas the *motor vehicles, parts and accessories* industry had a share of about 14%. The remaining three industries, i.e. *basic chemicals*, *other chemicals and man-made fibers*, and *television, radio and communication equipment*, had a constant share of approximately 6%. On the product line level, however, imports are more diverse than exports. Some product lines still worth mentioning are motor vehicles (incl. parts and accessories), automatic data processing machines (incl. parts and accessories), telephone sets, radios, televisions, medicines, additives for

mineral oils and graphite or carbon articles used for electrical purposes. The rise of the import share of the *other mining* industry aggregate, which was driven by the increased importance of crude petroleum oils and crude oils obtained from bituminous minerals is also remarkable. These products accounted for more than 10% of all imports in 2006. All in all, however, South Africa's imports were more diverse than its exports and consisted mainly of manufactures and consumer goods.

The overall import structure, however, is clearly composed of the different import patterns with the three trading partners (see Appendix C.2). Over 40% of imports originating from the EU are products of the *machinery and equipment* (mainly automatic data processing machines) as well as the *motor vehicles, parts and accessories* industry aggregates. Specific for the imports from the EU is also the importance of the *electrical machinery and apparatus* and the *professional and scientific equipment* industry aggregates in addition to the *basic chemicals*, the *other chemicals and man-made fibers* and the *television, radio and communication equipment* industry aggregates. Characteristic of the imports from China is the decreasing dominance of the *footwear*, the *textiles* and the *wearing apparel* industry aggregates. The combined share of these industry aggregates in 2006 was about 30% of all China imports. Simultaneous, however, the import share of the *machinery and equipment* and the *television, radio and communication equipment* industry aggregate increased significantly. Imports from the SADC countries on the other hand are mainly primary products and natural resources, such as crude petroleum oils, diamonds, nickel, copper and cotton. Although partly overlapping the import structures with respect to the EU, China and SADC are thus remarkably different.

In order to generate more insight on these trade patterns and the change of import and export flows over time it is necessary to use specific analysis tools. It is fruitful to analyse the trade structure with respect to intra-industry trade. Moreover, the concept of revealed comparative advantages points out the strengths and weaknesses of the South African economy on international markets. Finally, a dynamic measure, such as a marginal intra-industry trade index is needed to analyse the evolution of trade flows over time. In the next sections these tools will be presented and applied on the South African trade data.

1.4 Intra-Industry Trade

Increased trade openness can result in inter- or intra-industry trade. Whereas inter-industry trade (or specialised) trade implies that imports and exports originate from different industries, intra-industry trade is characterised by the fact that one industry imports and exports simultaneously. Accordingly, the distribution of the pains and gains of trade liberalisation will differ. Moreover, the specific trade pattern is also an indicator of how to model trade flows. One of the first papers to vocalise this topic and simultaneously to offer a measuring procedure was Grubel and Lloyd (1971). The index, later known as the Grubel-Lloyd index, presented in this paper compares the total trade of a specific industry, i.e. the sum of exports and imports, with the absolute value of net exports of this industry, i.e. the difference between exports and imports.

Formally the Grubel-Lloyd index (GL) for an industry i is defined as:

$$GL_i = \frac{(X_i + M_i) - |X_i - M_i|}{X_i + M_i} = 1 - \frac{|X_i - M_i|}{X_i + M_i} \tag{1.1}$$

The absolute difference between the export (X) and the import (M) values of industry i indicates the level of inter-industry trade. Since this value is normalised it can be subtracted from unity. The result is an index, which indicates the level of intra-industry trade in industry i. Moreover, the value of this index ranges between zero and one. It should be clear that zero indicates total inter-industry trade, whereas one represents a trade pattern characterised by intra-industry trade.

Besides this industry specific Grubel-Lloyd index an overall Grubel-Lloyd index of the whole economy can be calculated. This overall Grubel-Lloyd index is defined as the sum of the weighted industry Grubel-Lloyd indices. The interpretation of this index is similar as it gives an indication of the overall intra-industry level of trade. The formal definition of the overall Grubel-Lloyd index is:

$$GL = \sum_i \left(GL_i \cdot \frac{X_i + M_i}{\sum_i (X_i + M_i)} \right) = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i (X_i + M_i)} \tag{1.2}$$

The analysis by means of the Grubel-Lloyd index is based upon calculations in the HS 4-digit product level. Furthermore, in order to reduce data outliers the mean values of a three year period are used. In order to not only capture the values in the beginning and the end of the analysed time period also data in the middle (1998-2000) are reported. Table 1.1

shows Grubel-Lloyd indices for three different periods. What one notices immediately are the low values and the huge differences of these indices. South Africa's trade pattern was according to the Grubel-Lloyd index characterised by a high degree of inter-industry exchange in all three periods, although the overall value increased over the three time periods. In 2006 a share of 31.06% of all trade flows could be characterised as intra-industry trade. Just to get a notion of the magnitude one has to keep in mind that a Grubel-Lloyd index of 0.33 means that either exports or imports are five times as big as their respective counterpart. Although it is clear that this figure is lower for specific trade partners, the extreme low values for trade with the SADC and China are surprising.

	1993-1995	1998-2000	2004-2006
World	22.56%	27.12%	31.06%
EU	18.29%	23.95%	21.04%
SADC	11.90%	10.42%	6.19%
China	2.09%	3.86%	4.48%

Table 1.1: The overall Grubel-Lloyd index

The main reasons to use the Grubel-Lloyd index are its simple calculation and its straightforward interpretation. In addition, this measurement is broadly used in papers on the South African trade structure. Therefore, results of this analysis are comparable with existing literature. In general, other studies support the findings presented above. Isemonger (2000) estimated annual weighted Grubel-Lloyd indices for South Africa for the period 1993-1996 and found values ranging between 0.20 and 0.24. A Grubel-Lloyd index of 0.35 for the year 1998 is mentioned in Parr (2000). Petersson (2002) on the other hand finds a percentage share of intra-industry trade over 40%. This difference can be explained by referring to the used classifications. Petersson (2002) uses the Standard Industrial Classification 4-digit level and thus 118 commodities, in contrast to the 1811 product lines of the HS 4-digit classification. This higher level of disaggregation results automatically in lower levels of the Grubel-Lloyd index, because exports or imports are less matched with their respective counterpart.

1.5 Revealed Comparative Advantages

Although the Grubel-Lloyd index is an appropriate tool to analyse the intra-industry trade pattern, the made classification lacks a dimension.

There exists a structural difference between product groups characterised by inter-industry trade. Each product group classified as inter-industry trade has either a comparative advantage or a comparative disadvantage. In order to gain more information about strengths and weaknesses of South Africa's economy a revealed comparative advantage index is used.

The basic assumption of a revealed comparative advantage (RCA) measure is that an economy exports mainly products for which it has a comparative advantage and imports goods for which it has a comparative disadvantage. Due to this assumption trade flows can be used to reveal those industries with a comparative advantage or disadvantage. Balassa (1989) points out that the comparative advantage of an industry can be calculated by different means and develops a RCA indicator simultaneously. Since this indicator requires the collection of world export data for all product lines, another RCA index was looked for, which can be calculated without collecting new data. The concept of a RCA index is, however, not without any criticism and there are quite diverse opinions, on how such an indicator should look like (e.g. Bowen, 1983, 1986, Yeats, 1985, Vollrath, 1991).

Siebert (2000) offers an alternative RCA index, which compares exports and imports of one industry with total exports and imports of the economy. By means of this index South Africa's product lines with inter-industry trade character can be classified as product lines with either a comparative advantage or a comparative disadvantage. The used measure is formally defined as:

$$RCA_i = \left[\frac{X_i - M_i}{X_i + M_i} - \frac{\sum_i (X_i - M_i)}{\sum_i (X_i + M_i)}\right] \cdot \frac{100}{1 - \frac{\sum_i (X_i - M_i)}{\sum_i (X_i + M_i)}} \tag{1.3}$$

The first term within the square brackets normalises net trade of a specific industry i to the total trade of this industry. The right term within these brackets compares overall net trade with the total value of trade. The last term is a correction term for the balance of trade. If the economy has a balance of trade surplus, the RCA values become bigger. What should be clear from the construction of the measure is that an industry with a comparative advantage has a positive RCA value, whereas uncompetitive industries have negative RCA values. A competitive industry is thus an industry with a higher relative level of net trade than the overall economy. The magnitude of the comparative (dis)advantage is indicated

by the size of the RCA index.

Since it is rather unlikely that all product lines have a Grubel-Lloyd index close to zero or close to one, a cut-off value is needed to distinguish between products characterised by inter-industry trade and intra-industry trade. Similar to Parr (2000) this analysis uses a cut-off value of 0.65, i.e. products with a Grubel-Lloyd index above 0.65 are defined as intra-industry. This cut-off value is a reasonable criterion, since a Grubel-Lloyd value of 0.65 means that within one product line either exports or imports are about twice the value of its counterpart. After identifying product lines with inter-industry trade character, the RCA index can be deployed to distinguish products for which the South African economy has a comparative advantage from those with a comparative disadvantage.

	Advantage		Disadvantage		Intra-Industry	
	Product share	Trade share	Product share	Trade share	Product share	Trade share
2004-2006	21.77%	36.81%	58.04%	44.45%	20.19%	18.73%
1998-2000	26.35%	44.67%	52.10%	43.09%	21.56%	12.25%
1993-1995	25.04%	48.97%	57.92%	44.71%	17.04%	6.32%

Table 1.2: The overall RCA distribution

The data for the period 2004-2006 show that almost 60% of all product lines could be classified as disadvantageous (see Table 1.2). These product lines accounted for around 45% of total trade in this time period. Moreover, in the two other time periods these figures were roughly the same. The remaining product lines were equally divided between the intra-industry trade and advantageous. Over time a small decrease of the number of advantageous product lines in favour of intra-industry ones is observable. With respect to the trade share of these products, the evolution is, however, more remarkable. Whereas in 1993-1995 the trade share of advantageous products was around 49%, this share decreased to 37% in 2004-2006. Simultaneously, the trade share of the intra-industry products increased by twelve percentage points to a trade share of around 18%. Notwithstanding these changes, the data support the overall assumption that the South African trade pattern is an inter-industry trade pattern.

At industry levels the dominance of inter-industry trade is also observable for the period 2004-2006. In Table 1.3 the distribution within industries with a high trade share are shown. Within the *agriculture, forestry and fishing*, the *basic iron and steel*, and the *basic non-ferrous metals* indus-

	Advantage		Disadvantage		Intra-Industry	
	Product share	Trade share	Product share	Trade share	Product share	Trade share
Agriculture, forestery and fishing	40.20%	67.33%	44.12%	27.71%	15.69%	4.96%
Basic chemicals	25.20%	32.90%	53.66%	39.17%	21.14%	27.93%
Basic iron and steel	41.67%	84.40%	36.11%	4.62%	22.22%	10.98%
Basic non-ferrous metals	40.32%	91.35%	37.10%	5.38%	22.58%	3.27%
Food	31.25%	37.43%	46.43%	49.43%	22.32%	13.13%
Machinery and equipment	5.94%	16.60%	85.15%	80.56%	8.91%	2.84%
Motor vehicles, parts and accessories	21.43%	3.27%	28.57%	33.74%	50.00%	62.99%
Other chemicals and man-made fibres	9.20%	3.69%	67.82%	73.18%	22.99%	23.13%
Other mining	46.15%	36.96%	38.46%	61.59%	15.38%	1.45%

Table 1.3: The 2004-2006 RCA distribution for some selected industries

try aggregates 40% of all products are classified as advantageous and contribute the lion's share to trade in these industries. Within the *basic chemicals* and *food* industry aggregates the distribution is more balanced, but specialised trade still accounts for at least 70% of trade. The *machinery and equipment*, the *other chemicals and man-made fibres* and the *other mining* industry aggregates are characterised by a high proportion of disadvantageous product lines. Moreover, except for the *other chemicals and man-made fibres* industry, trade shares of the intra-industry products are negligible. What is remarkable is that the *motor vehicles, parts and accessories* industry aggregate is an exception to the dominance of specialised trade. Within this industry intra-industry trade products are dominating both in number as well as in trade share. Furthermore, whereas in the other discussed industries only marginal change happened, the trade pattern of the *motor vehicles, parts and accessories* industry aggregate experienced a major structural change. In the 1993-1995 period still some 85% of all product lines were classified as disadvantageous and accounted for 95% of trade in this industry. These data thus show that the MIDP had a significant impact. Notwithstanding the structural change in the *motor vehicles, parts and accessories* industry aggregate, the South African economy has mainly comparative advantages in primary products and comparative disadvantages in consumer and capital goods.

Between the three trading partners there are significant differences. As shown in Figure 1.2 only a small share of product lines is classified as intra-industry trade. Moreover, the combined trade share of the advantageous and the disadvantageous product lines exceeds 90% for each of the three partners. In addition, the difference between the trade pattern with the SADC on the one hand and the trade pattern with the EU and China on the other is remarkable. Trade between South Africa and the SADC is mainly in favour of the former, whereas South Africa has only a small number of advantageous product lines with respect to the EU

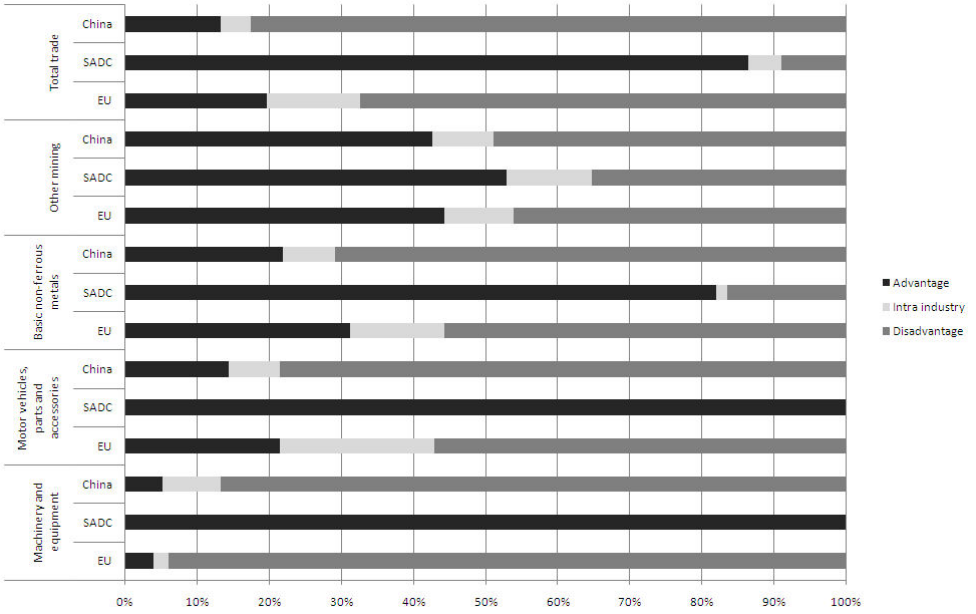

Figure 1.2: The 2004-2006 RCA distribution for selected trading partners and industries

and China. Figure 1.2 also displays the distribution amongst the four industry aggregates with the highest overall trade share in the 2004-2006 period. What is remarkable in Figure 1.2 is the phenomenon that the advantage share of trade with the SADC moves in the opposite direction as the advantage share of the remaining trading partners. The comparative advantage of the South African economy with the SADC is relative small in the *other mining* industry aggregate, whereas its comparative advantage in this industry is relatively high with respect to the EU and China. This is probably explained by the rich endowment of South Africa and its neighbouring countries with natural resources. Simultaneously, however, in the other industry aggregates the share of product lines with a comparative advantage is small with respect to the EU and China and high with respect to the SADC. South Africa is thus less competitive in processing and manufacturing industries than the EU and China, but its economy is highly competitive within the SADC.

Based upon the different analysis results from this and previous sections it can be concluded that South Africa is mainly a supplier of minerals, metals and other natural resources, as well as agricultural products. Simultaneously, it imports mainly consumer goods, capital equipment

and crude oil. Although one of the aims of the new government was to diversify trade by building up an international competitive manufacturing industry, South Africa's trade structure in the 2004-2006 period was still characterised by inter-industry trade. Furthermore, one gets the impression that the South African economy is stuck in the middle between highly competitive emerging countries such as China, industrialised countries and its African neighbours. South Africa supplies both emerging and industrialised countries with natural resources. From the emerging country South Africa buys low-tech manufactures such as clothing and IT hardware, whereas high-tech products (e.g. pharmaceuticals and medical equipment) are purchased in the EU. The analysis also shows the dominant position of South Africa within the SADC. In the following step it is necessary to investigate how this trade pattern has changed over time.

1.6 Marginal Intra-Industry Trade

An extra measure to analyse the evolution of the trade pattern is necessary, because the Grubel-Lloyd index is not a dynamic measure. Due to its definition a change of this index can have multiple causes and an increase of the Grubel-Lloyd index does not necessarily mean an increased level of intra-industry trade change. (Brülhart, 1994) To overcome this problem dynamic indices which measure the change in intra-industry trade were developed (e.g. Greenaway et al., 1994, Brülhart, 1994, Azhar et al., 1998).

The further analysis uses the B index, which was developed in Brülhart (1994), as marginal intra-industry trade index. This index does not only allow a differentiated interpretation of trade structure changes, but it is handy as well as easy to apply. The index measures marginal intra-industry trade, i.e. the change in exports and imports of a specific industry i between two periods. The indicator is defined as:

$$B_i = \frac{\Delta X_i - \Delta M_i}{|\Delta X_i| + |\Delta M_i|} \tag{1.4}$$

By means of the value of this index, all observations can be classified into three different groups. Since the value of this index ranges between minus one and one, three theoretic classes can be constructed. Industries with a B index value close to zero are characterised by intra-industry

trade change over time. In these industries export and import changes are roughly the same. Industries with a B index value close to one are industries into which the economy specialises. If the B index is close to minus one, the economy specialises out of this industry. Moreover, this classification can be combined with the classification from the former sections.

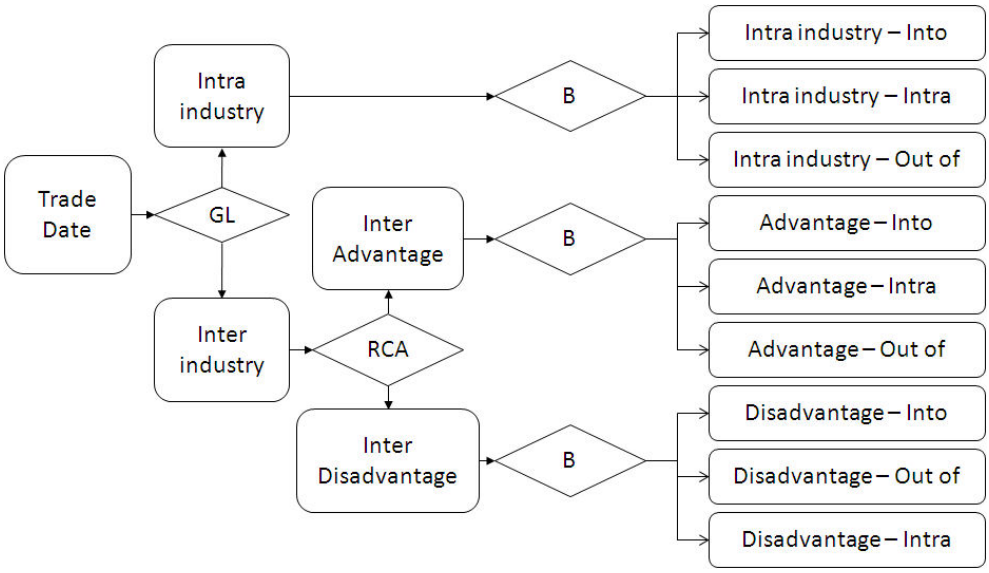

Figure 1.3: Classification method

In Figure 1.3 the developed analysis process is visualised. In the first step the Grubel-Lloyd index is used to distinguish between product lines with an inter- and an intra-industry trade pattern. Since the aim of the analysis is to explore the evolution of the trade pattern from 1993 to 2006, the Grubel-Lloyd values of the 1993-1995 period are used. In the next step product lines with an inter-industry trade pattern are divided into product lines with a comparative advantage and disadvantage. In this step the RCA values of the period 1993-1995 are used and the results are therefore slightly different from the results from the previous section. Finally the B index is used to subdivide the three classes by means of the differences between the 1993-1995 and the 2004-2006 period. The result is a classification of the product lines into nine different classes.

Similar to the Grubel-Lloyd index cut-off values are needed to carry through the classification based on the B index. Since the considerations made with respect to the Grubel-Lloyd index are also valid concerning

the B index, the used cut-off values are 0.65 and -0.65. Table 1.4 shows the results of the analysis in different dimensions. One can observe that the classes Advantage-Into and Disadvantage-Out of, two classes which deepen inter-industry trade, are dominating both with respect to the share of product lines as well as the trade share. Comparing the trade share of these product lines over time also shows that the two classes became even more important. The Advantage-Intra and Disadvantage-Intra classes are also worth mentioning. In the overall trade pattern with the world they account for a significant share of product lines and of trade. With regard to the trading partners, however, this significance vaporises. The only exception is the Disadvantage-Intra class in the EU-South Africa trade relation. Finally, the decrease of the trade share of the Advantage-Out of and the Disadvantage-Into, two classes which could increase the intra-industry trade pattern, is remarkable. Trade with product lines in these classes decreased. To draw a conclusion from this analysis it can be stated that South Africa's trade pattern was characterised by inter-industry trade in 1993 and that from 1993 until 2006 this pattern did not change much.

		World			EU		
		Trade share 1993-1995	Trade share 2004-2006	Product share	Trade share 1993-1995	Trade share 2004-2006	Product share
Advantage	Into	27.29%	27.40%	9.13%	24.65%	26.43%	8.24%
	Intra	12.41%	9.76%	8.52%	4.48%	3.03%	3.05%
	Out of	9.27%	1.08%	7.39%	5.71%	0.68%	8.24%
Disadvantage	Into	4.54%	2.45%	7.77%	7.72%	2.29%	16.63%
	Intra	18.31%	20.05%	21.57%	15.34%	18.68%	13.04%
	Out of	21.86%	30.35%	28.58%	37.62%	40.51%	38.98%
Intra Industry	Into	0.77%	2.37%	2.26%	1.33%	5.87%	2.06%
	Intra-	4.35%	5.26%	9.58%	2.43%	1.90%	5.19%
	Out of	1.20%	1.29%	5.20%	0.73%	0.60%	4.58%
		SADC			China		
		Trade share 1993-1995	Trade share 2004-2006	Product share	Trade share 1993-1995	Trade share 2004-2006	Product share
Advantage	Into	63.62%	66.87%	61.61%	15.11%	14.29%	4.65%
	Intra	0.89%	0.74%	3.88%	0.83%	0.57%	1.51%
	Out of	13.67%	8.21%	10.74%	17.10%	1.34%	6.05%
Disadvantage	Into	6.35%	4.54%	9.60%	2.64%	1.89%	6.92%
	Intra	3.66%	1.82%	3.05%	3.09%	1.66%	5.19%
	Out of	6.81%	13.83%	3.27%	59.83%	73.61%	72.43%
Intra Industry	Into	3.20%	2.03%	4.65%	0.25%	0.12%	0.22%
	Intra-	1.29%	1.59%	2.13%	0.61%	3.05%	1.08%
	Out of	0.50%	0.37%	1.07%	0.55%	3.46%	1.95%

Table 1.4: Classification results

Whereas in Parr (2000) the ratio between product lines classified as specialisation into and product lines classified as specialisation out of is three

to one, the ratio for the present analysis is around one to two. The main reason for this difference is the fact that (Parr, 2000) considers only 743 manufacturing industries during a shorter time period and does not make the initial difference between industries characterised by intra-industry trade and inter-industry trade. As a result Parr (2000) looks favourably upon the fact that around one quarter of all industries displayed intra-industry trade growth. His optimism is not shared by the results of this thesis.

Isemonger (2000, 60) states that "There is [...] a very definite upward trend in the overall level of intra-industry trade, manifested at both the chapter level and the economy level, for the period estimated." This upward trend is also present in the above analysis. The analysis, however, does not share the general conclusion of Isemonger (2000, 60) that "[...] South Africa's trading pattern is becoming increasingly diversified." The increase of the intra-industry level observed between 1993 and 2006 has different causes. Between the 1993-1995 and the 2004-2006 periods around 25% of industries changed their RCA status. The net result is that the advantage and the disadvantage classes contributed respectively one and two percentage points to the three percentage points increase within the intra-industry class. With respect to trade shares, the effect was clearly an increase of intra-industry trade within the South African economy. However, there is also a second effect. During the observed period the trade share of those products which classification switched from advantage to intra-industry trade decreased. The trade share of the product lines, which had a comparative disadvantage over the whole period, increased. All in all, the increased level of intra-industry trade is caused by a reduction of exports with a comparative advantage and by the increased export diversification within the *motor vehicles, parts and accessories* industry aggregate due to the MIDP. This claim is thus more accurate than the conclusion of Isemonger (2000).

1.7 Factor Intensities and Trade Flows

As mentioned this analysis combines the HS 6-digit classification with the South African Standard Industry Classification. This approach offers the possibility to combine production factor information with trade data on an industry level. With respect to these production factors the RSA Standardised Industry data base (Quantec, 2007a) covers capital and employment data. Although the data on capital use make a distinc-

tion between machinery, buildings and transportation equipment, the following analysis aggregates these data to one production factor. Moreover, employment figures consist of four categories, i.e. *Formal Highly skilled*, *Formal Skilled*, *Formal Semi- and unskilled* and *Employment informal: Total*. The employment data in this analysis, however, distinguishes only between skilled labour, which equals the *Formal Highly skilled* aggregate, and less-skilled labour, which is the sum of the remaining three classes. It may seem awkward to classify the *Formal Skilled* aggregate as less-skilled labour, but if one takes the definition [4] of this class into account it makes sense. As a result it is possible to consider the production structure of the different industry aggregates with respect to capital (K), skilled labour (H) and less-skilled labour (L).

In the following chapter factor intensity with respect to three production factors will be discussed thoroughly, but for now it is sufficient to use a more straightforward method. In a first step the capital intensity of an industry is analysed by comparing the amount of capital used in that industry with the sum of employees in this industry. In a second step the ratio between skilled and less-skilled labour is calculated. Figure 1.4 displays the results for the most relevant industry aggregates with respect to trade. Note that the Y-axis of Figure 1.4 uses a logarithmic scale.

All industries displayed in Figure 1.4 contribute significantly to exports and/or imports with respect to overall trade or to trade with one of the trading partners. One possible explanation for these different trade flows could be the different use of production factors for export and imports. Therefore, this production structure should be considered when discussing the trade pattern. In general, the lion's share of export flows originate from capital intensive industries. This observation is also valid for the export structure with the three trading partners. In addition, to capital intensive products also skilled labour intensive products are exported to the SADC. Imports from the EU are either capital or skilled labour intensive, whereas less-skilled labour intensive products are imported from China and the SADC. It can thus be claimed, that South Africa is an exporter of capital intensive products and imports a high share of labour intensive products.

[4] The Qunatec data base defines skilled labour as follows: clerical occupations; sales occupations; transport, delivery and communications occupations; service occupations; farmer, farm manager; artisan, apprentice and related occupations; production foreman, production supervisor (Quantec, 2007a)

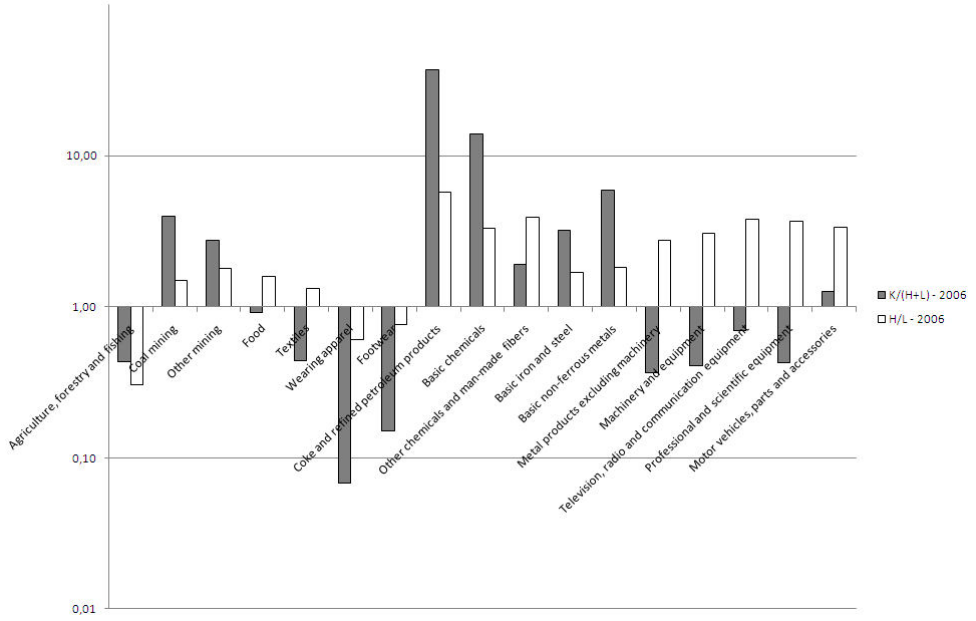

Figure 1.4: Factor intensities for some industries

1.8 Conclusion

In summary, this chapter shows that the trade policy of the new government resulted in the reintegration of South Africa in the world economy, both export and import shares did increase significantly between 1993 and 2006. The analysis of these trade flows by means of a comprehensive approach shows the peculiar character of this reintegration. In general, it can be claimed that the South African trade pattern, which was characterised by inter-industry trade, did not change over the considered time period. South Africa remained a supplier of minerals and metals originating from the *basic iron and steel*, the *basic non-ferrous metals*, the *coal mining* and the *other mining* industry aggregates. However, it is probable that the MIDP did influence the exports of the *motor vehicles, parts and accessories* and the *machinery and equipment* (mainly centrifuges) industry aggregates. According to the production figures at hand these exports can be regarded as being capital intensive. This observation holds not only on a general level, but also with respect to the EU and China. Export flows to the SADC, however, are remarkably different. They are more diverse and include products of the *basic chemicals*, the *other chemicals and man-made fibres* as well as the *machinery and equipment* industry aggregates. The production of these exports is

also more skilled labour intensive.

Whereas South Africa remained a main supplier of natural resources to the world, its import structure was clearly composed of the different import patterns with the three trading partners. Imports from the EU could be classified to the *machinery and equipment*, the *motor vehicles, parts and accessories*, the *electrical machinery and apparatus*, *basic chemicals*, the *other chemicals and man-made fibres*, the *television, radio and telecommunication equipment* and the *professional and scientific equipment* industry aggregates and were thus more diverse than exports to this region. Moreover, the production of these imports were mainly skilled labour and capital intensive. Imports from China were more less-skilled labour intensive, although the import share of the *footwear*, the *textiles* and the *wearing apparel* industry aggregates did decrease over time. Simultaneously, the import share of the *machinery and equipment* and the *television, radio and telecommunication equipment* increased. Imports from the SADC were on their turn mainly primary products and natural resources, which are partly capital intensive and partly less-skilled labour intensive.

With regard to these different export and import flows it is not surprising that the level of intra-industry trade is rather low. Moreover, research displays a structural difference between the three trading partners. Therefore, it can be stated that the semi-industrialised economy of South Africa is stuck in the middle between China, an emerging developing country with a highly competitive economy, the EU with its mature economy and the developing economies of the SADC. Whereas South Africa has a high share of industries and products with a comparative advantage with respect to its neighbouring countries, comparative advantages vis-à-vis the industrialised and emerging economies are concentrated on natural resources. This trade pattern could be the result of an anti-export biased trade regime. In conclusion, South Africa exports capital, whereas it imports labour. This specific trade structure will be modelled in the next chapter.

Chapter 2

Clockwork Economy

2.1 Introduction

The descriptive analysis of the trade structure of the South African economy in the previous chapter displayed its peculiar position within the world economy. In addition, the dynamic analysis showed how this trade pattern changed in the wake of trade liberalisation. If the factor intensities and the production structure of imports and exports are taken into account, it can be argued that this trade pattern can partly be explained by the different use of production factors. This is especially true if one considers the trade pattern between South Africa, China and the EU. It is the aim of this chapter to construct a theoretical framework that models this trade pattern and its evolution.

One trade model that explains trade flows based on different production factors is the Heckscher-Ohlin trade model. Within this model countries will export the good which uses a production factor that is abundantly available within the economy, whereas imports use a scarce production factor intensively. According to this model countries trade with each other due to different factor endowments. This model seems appropriate to discuss the theoretical framework of South African trade. It should, however, be clear that the Heckscher-Ohlin-Samuelson model, the two-dimensional trade model commonly known from textbooks, is not applicable. Besides the fact that the model should consider three trading partners, it should also comprise trade with three different products. These challenging requirements are the subject of this chapter.

The first section describes the basic structure of the Heckscher-Ohlin trade model. The main assumptions concerning production structure, factor markets and consumer markets are discussed. Moreover, the mathematical interpretation of these assumptions are introduced. It will be shown that the notion of factor intensity is a major challenge. Therefore, the second section discusses this problem and offers a possible solution. Based on this solution assumptions concerning the factor intensity within industries are formulated. In the third section the concept of the endowment triangle is introduced. This concept allows for a graphical analysis of the model based on factor endowment assumptions. The same technique is used in the fourth section to explain the concept of the triangles of diversification. Moreover, these triangles of diversification are combined with the assumptions concerning factor intensities within industries. In the fifth section the insights of the model are combined within the framework of the endowment triangle and of the triangles of diversification. The result is an Heckscher-Ohlin trade model which meets the above defined requirements. By means of this model trade flows between South Africa, the EU and China are discussed. The last section is a comparative static analysis for South Africa. In this section the autarkic situation is compared with the free trade situation. The chapter ends with a general conclusion.

2.2 Basic Structure

The best known Heckscher-Ohlin trade model is without any doubt the Heckscher-Ohlin-Samuelson trade model. This model was named after Paul Samuelson to honour his contributions to the development of a two-dimensional Heckscher-Ohlin trade model. This two-dimensional framework exhibits some interesting properties such as the Heckscher-Ohlin theorem, the Stolper-Samuelson theorem, the Rybczynski theorem and the factor price equalisation theorem. This trade model with two production factors and two commodities is, however, not appropriate to analyse the South African trade pattern.

Although exports from South Africa to both the EU and China are similar, imports originating from the EU are partly different from those originating from China. Therefore, it is necessary to consider a model with at least three commodities. Furthermore, it is necessary that the model distinguishes explicitly between three different production factors. As the previous chapter showed EU imports are generally more capital and

skilled labour intensive, whereas Chinese imports are overall more less-skilled and skilled labour intensive. Simultaneously, South African exports are capital intensive. In conclusion, a three-dimensional Heckscher-Ohlin trade model with three commodities and three production factors has to be developed.

In order to develop such a model this section refers to the rich literature concerning multi-dimensional trade models. One of the first papers that dealt with such a trade model was Samuelson (1953). In general, he discussed the solvability of multi-dimensional trade models within the framework of the general equilibrium theory. Moreover, the paper started a vivid debate amongst scholars in international trade, which was partly summarised by Chipman (1966). Besides an in-depth analysis of the Leontief Paradox, the summary also treated the factor price equalisation theorem and the Stolper-Samuelson theorem in a multi-dimensional environment. These two theorems are also the topic of Chipman (1969). The analysis in this paper covered three topics: the univalence problem (i.e. factor intensity reversal and the possibility of unequal numbers of commodities and factors), the weak Stolper-Samuelson criterion and the strong Stolper-Samuelson criterion. These two versions of the Stolper-Samuelson theorem will also be discussed in this section. Another contribution to this literature was Chang (1979), which analysed the mathematical properties of the matrices of a multi-dimensional model. In the beginning of the 1980s two surveys dealing with multi-dimensional models in the theory of international trade were published. Both Takayama (1981) and Ethier (2003) give a good overview of the development of this research field and summarise the main findings. It are these findings and insights that will be used to construct the three-dimensional model of international trade.

Under the assumption of perfect competition on factor and commodity markets the mathematical basics are straightforward. Let p, w, x and v respectively be the commodity price vector, the factor price vector, the output vector and the endowment vector. Let matrix A be the input-output coefficient matrix in which the element a_{ij} denotes the amount of factor i needed to produce one unit of commodity j. As all ready indicated only three industries will be considered, i.e. $j = 1, 2, 3$. Furthermore, the production factors are capital (K), skilled labour (H) and less-skilled labour (L), i.e. $i = K, H, L$. The general equilibrium of this model can then be described by the market clearing condition and the zero-profit

condition. The mathematical formulation of these conditions are:

$$A \cdot x = v \tag{2.1}$$

$$A' \cdot w = p \tag{2.2}$$

The market clearing clearing condition (2.1) states that none of the production factors is unemployed. The zero-profit condition (2.2) describes the assumption that none of the industries make pure profit. With respect to the production function assume that the production function, f_j, is homogeneous of the first order, i.e. characterised by constant returns to scale. Moreover, production functions are smooth and marginal returns diminish for each production factor, or

$$\frac{\partial f_j}{\partial v_{ij}} > 0 \quad \text{and} \quad \frac{\partial^2 f_j}{(\partial v_{ij})^2} < 0 \quad \text{for all } i \text{ and } j \tag{2.3}$$

Based upon the assumption of perfect competition it is straightforward that the remuneration of the factors equals their marginal product. Since each factor can move freely between industries and markets are competitive, the marginal productivity of one specific factor will be the same in each industry.

$$\frac{w_i}{p_j} = \frac{\partial f_j}{\partial v_{ij}} \tag{2.4}$$

Consumers are assumed to derive an income on the factor market. Simultaneously, they spend this income on the commodity market. Moreover, consumers have homothetic tastes. As a result, production equals consumption in the autarkic situation and national income, Y, can be written either as a function of the factor price vector, w, and the output vector, x, or as a function of the endowment vector, v, and the price vector, p:

$$Y \equiv p' \cdot x = (A' \cdot w)' \cdot x = w' \cdot A \cdot x = w' \cdot v \tag{2.5}$$

Takayama (1981) shows that with respect to this function the matrix $[\partial w/\partial v]$ is symmetric and negative semidefinite and the matrix $[\partial x/\partial p]$ is symmetric and positive semidefinite, i.e. $Y(v, p)$ is concave in v and convex in p. Furthermore, Takayama (1981) shows that both the Rybczynski and the Stolper-Samuelson matrix are mutations of the input-output coefficient matrix A:

$$\text{Rybczynski matrix}: \quad \frac{\partial x}{\partial v} = A^{-1} \tag{2.6}$$

$$\text{Stolper-Samuelson matrix}: \quad \frac{\partial w}{\partial p} = (A')^{-1} \tag{2.7}$$

From the mathematical deduction it is clear that the Rybczynski matrix (2.6) describes the change in output of industry j due to a change of a specific production factor i under the assumption of constant relative prices. This matrix thus describes the Rybczynski theorem that states that, *ceteris paribus*, an increase in the endowment of factor i will increase the production of the industry that uses this factor i intensively. Whereas the Rybczynski matrix describes the relationship between factor endowments and production output, the Stolper-Samuelson matrix (2.7) displays the relationship between factor remunerations and commodity prices. As will be shown in the remainder of this chapter a price increase of commodity j will induce, *ceteris paribus*, an increase of the remuneration of the factor that is used intensively in the production of commodity j. Although both the Rybczynski theorem and the Stolper-Samuelson theorem in a three-dimensional trade model are similar to the two-dimensional theorems, the signs of the coefficients are dependent on the assumptions concerning production technology and will be discussed later in this chapter.

With respect to the factor price equalisation theorem scholars emphasise the distinction that should be made between the local and the global version of this theorem. Chipman (1969, 399) gives a clear summary of the basic problem: "It is one thing to say that, given any initial equilibrium position, there exists a one-to-one association between commodities and factors such that a change in any commodity price will lead to a more than proportionate change (in the same direction) in the corresponding factor price. It is quite another thing to state that it is possible to find a one-to-one association between goods and factors *in advance* such that, starting from any equilibrium, a change in any commodity price will lead to a more than proportionate change in the price of the *already specified* factor." The former situation is known as the local factor price equalisation theorem, the latter as the global factor price theorem.

This topic is also discussed by Takayama (1981). If it is the case that the number of production factors equals the number of commodities the local price equalisation theorem holds. On the one hand the rang of the matrix $[\partial w/\partial p]$ equals the number of commodities. On the other hand $dw = [\partial w/\partial v]\, dv + [\partial w/\partial p]\, dp = [\partial w/\partial p]\, dp$, because under profit maximisation $[\partial w/\partial v] = 0$. Consequently the matrix $[\partial w/\partial p]$ is nonsingular

and the local price equalisation theorem holds. For the global factor price equalisation theorem to hold it should be asserted that the price vector, p, as a function of the factor price vector, w, is globally invertible with respect to w. Takayama (1981) proves by means of the Gale-Nikaido theorem that a sufficient condition is that all principal minors of the input-output coefficient matrix A are positive.

By now the basics of the model have been displayed. One topic, however, on which most publications do not elaborate is the notion of factor intensity. In fact, although the issues of a multi-dimensional trade model are discussed, most scholars argue by means of the two-dimensional notion of factor intensity. One exception is Jones and Scheinkman (1977), which offers a workable definition of factor intensity in a multi-dimensional framework. This will be the topic of the following section.

2.3 Factor Intensity

Within the common two-dimensional trade model "a double bilateral comparison is involved, i.e. a ratio of two factors compared between two industries." (Jones and Scheinkman, 1977, 912) If, however, more than two factors are used in the production of a good, this notion of factor intensity is confusing. As pointed out by Jones and Scheinkman (1977) two equivalent alternatives can be used. The first alternative bases upon the use of the distributive share of a factor. This share within a specific industry, θ_{ij}, is the share of the product price p_j that is used to remunerate factor i and defined as:

$$\theta_{ij} = \frac{a_{ij} \cdot w_i}{p_j} \tag{2.8}$$

$$0 < \theta_{ij} < 1 \quad \text{and} \quad \sum_i \theta_{ij} = 1 \tag{2.9}$$

The distributive share of a factor within the overall economy, γ^i, is the share of national income that can be allocated to factor i and is defined as:

$$\gamma^i = \frac{w_i \cdot v_i}{Y} \quad \text{and} \quad \sum_i \gamma^i = 1 \tag{2.10}$$

By comparing the distributive share of a factor within an industry with its share in the total economy it is possible to make a statement concerning factor intensity. If in a specific sector a factor's share is higher than

its overall income share, then the sector uses this factor intensively.

The second approach compares the fraction of factor i employed in industry j, λ_{ij}, with this industry's share in total production, γ_j. Once again, if the former share is higher than the latter, it is said that the industry uses that factor intensively. The mathematical definitions of the two shares are:

$$\lambda_{ij} = \frac{a_{ij}x_j}{v_i} \quad \text{and} \quad \sum_j \lambda_{ij} = 1 \tag{2.11}$$

$$\gamma_j = \frac{p_j \cdot x_j}{Y} \quad \text{and} \quad \sum_j \gamma_j = 1 \tag{2.12}$$

Although the two approaches to asses factor intensity use different ratios, the outcome is the same. If z_{ij} is defined as the indicator of factor intensity of factor i in sector j than it can easily be shown that:

$$z_{ij} \equiv \frac{\theta_{ij}}{\gamma^i} = \frac{\frac{a_{ij}\cdot w_i}{p_j}}{\frac{w_i \cdot v_i}{Y}} = \frac{\frac{a_{ij}}{p_j}}{\frac{v_i}{Y}} = \frac{\frac{a_{ij}}{v_i}}{\frac{p_j}{Y}} = \frac{\frac{a_{ij}x_j}{v_i}}{\frac{p_j \cdot x_j}{Y}} = \frac{\lambda_{ij}}{\gamma_j} \tag{2.13}$$

Note that due to the definition of the indicator of factor intensity each industry uses at least one factor intensively. Moreover, if the work of Batra and Casas (1976) is included, the distributive share of a factor, θ_{ij}, can be interpreted as an elasticity coefficient. It shows the change in the price of the good with respect to the change of a factor's price. The authors showed that:

$$\sum_i \theta_{ij} \cdot \dot{w}_i = \dot{p}_j \quad \text{with} \quad \dot{w}_i = \frac{dw_i}{w_i} \quad \text{and} \quad \dot{p}_j = \frac{dp_j}{p_j} \tag{2.14}$$

By means of this equation it is straightforward to show that the distributive share of a factor, θ_{ij}, is an elasticity coefficient. It indicates the price reaction of commodity j on the price change of factor i. Under the assumption that the price of only one factor changes the equation can be deduced to:

$$\theta_{ij} \cdot \dot{w}_i = \dot{p}_j \tag{2.15}$$

$$\Leftrightarrow \theta_{ij} \cdot \frac{dw_i}{w_i} = \frac{dp_j}{p_j} \tag{2.16}$$

$$\Leftrightarrow \theta_{ij} = \frac{\frac{dp_j}{p_j}}{\frac{dw_i}{w_i}} \tag{2.17}$$

Although the previous mathematical discussion offers great insights into the basics of the three-dimensional model, it also uncovers some general problems with regard to these three dimensions. One of the major challenges is the definition of factor intensity. Contrary to the two-dimensional model, a double bilateral comparison is no longer appropriate. In fact, the double bilateral comparison yields ambiguous results. Moreover, in order to solve the abstract mathematical model some further assumptions have to be made. In order to make the discussion more explicit the next sections will introduce and apply a graphical method. This method consists out of the endowment triangle which is also known as the Leamer Triangle. (Jones and Marjit, 1991)

2.4 The Endowment Triangle

The fact that three production factors are taken into account does not only complicate the mathematical treatment of the model, but it also makes a clear graphical representation difficult. Nonetheless, it is possible to represent the three-dimensional framework in a two-dimensional space by means of the endowment triangle. In the context of trade theory this method was first applied by McKenzie (1955). Although his discussion is kept explicitly general for an indeterminate number of factors, the three-dimensional case is used to illustrate main arguments. Due to the common assumption of homogeneous production functions in the theory of international trade, McKenzie (1955) uses insights of activity analysis to discuss the factor price equalisation theorem. Therefore, it is not surprising that main features of the endowment triangle were in fact already discussed by Koopmans (1951) within an activity analysis framework. In this section the basic concept of the endowment triangle is displayed and discussed.

Whereas the three-dimensional representation of the model uses the absolute endowments of countries, the endowment triangle maps relative endowments in a two-dimensional space. Figure 2.1 helps to understand the concept of the endowment triangle and the transformation which takes place. Within this figure a three-dimensional factor space consists out of three orthogonal axes, each representing a specific factor. Therefore each factor endowment equals a three-dimensional vector. If, however, a plane is put through the positive orthant of this space and this plane intersects the three axes, two-dimensional vectors can be used as endowment vectors. The form of this plane will always be a triangle,

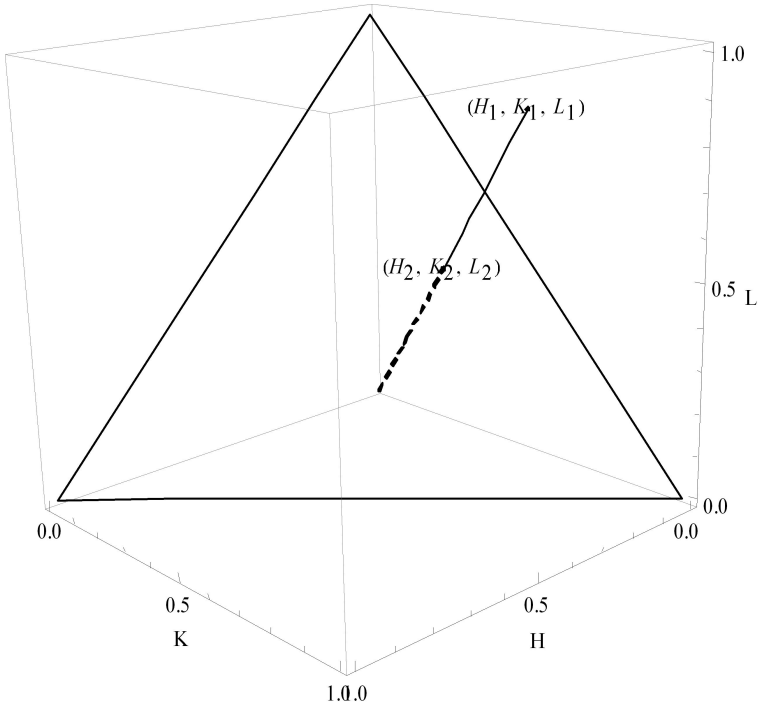

Figure 2.1: The construction of an endowment triangle

as can be seen in Figure 2.1. Any point in the three-dimensional space can now be represented by a point on this triangle. This point is defined as the point where the line defined by the three-dimensional origin and the three-dimensional point intersects the triangle.

The endowment triangle constructed in Figure 2.1 is defined by the points $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$. One of the vertices has to be defined as the origin of the endowment triangle and thus as origin of the two-dimensional space. Two edges of this triangle can now be used as axes of the two-dimensional space. In this case assume that point $(1, 0, 0)$ is the origin. Moreover, the new origin can be combined with the remaining two vertices to define two three-dimensional vectors, v_1 and v_2:

$$v_1 = \begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} - \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \tag{2.18}$$

$$v_2 = \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} - \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \tag{2.19}$$

By means of these vectors it is now possible to rewrite the coordinates of the vertices of the endowment triangle. This is done the following way:

$$\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + 0 \cdot v_1 + 0 \cdot v_2 \Rightarrow (0,0) \tag{2.20}$$

$$\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + 1 \cdot v_1 + 0 \cdot v_2 \Rightarrow (1,0) \tag{2.21}$$

$$\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + 0 \cdot v_1 + 1 \cdot v_2 \Rightarrow (0,1) \tag{2.22}$$

After discussing the basics of the triangle the time has come to define the transformation of points in the three-dimensional space onto this triangle. Consider point (H_1, K_1, L_1) in Figure 2.1. The line defined by this point and the origin of the three-dimensional space intersects the endowment triangle in a specific point, in this case point (H_2, K_2, L_2). Although the coordinates of the point (H_2, K_2, L_2) on the endowment triangle are different to those of point (H_1, K_1, L_1), the relative ratios of these coordinates are the same. Therefore, the point (H_2, K_2, L_2) can be used to represent the original point (H_1, K_1, L_1). The mathematical transformation of the coordinates is:

$$\begin{pmatrix} H_1 \\ K_1 \\ L_1 \end{pmatrix} \cdot c = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + \alpha \cdot v_1 + \beta \cdot v_2 \tag{2.23}$$

$$\Rightarrow \begin{cases} H_1 \cdot c = 1 - \alpha - \beta \\ K_1 \cdot c = \alpha \\ L_1 \cdot c = \beta \end{cases} \quad \text{with} \quad c = \frac{1}{H_1 + K_1 + L_1} \tag{2.24}$$

By means of this transformation it is now possible to simplify the three-dimensional space into a two-dimensional one. This two-dimensional space is the endowment triangle and has some specific features. Since the vertices of the triangle coincide with the axes of the three-dimensional space, each vertex represents one specific production factor. Moreover, "*every endowment point on a straight line emanating from one corner of the triangle has the same ratio of the other two factors.*" (Leamer, 1987, 964, original italics). This will be shown by means of Figure 2.2. Note

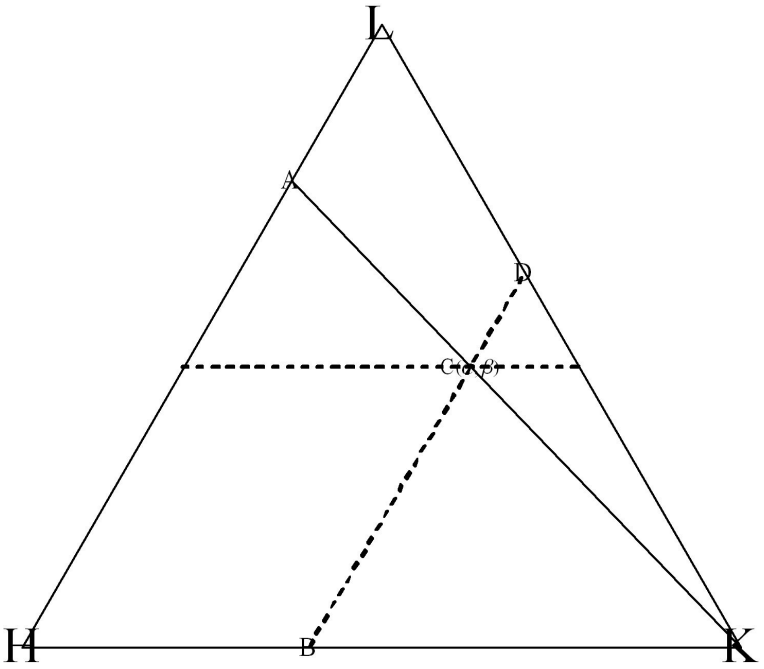

Figure 2.2: Point (H_1, K_1, L_1) in the endowment triangle

that the approach in this chapter does not use barycentric coordinates as opposed to Leamer (1987) and Jones and Marjit (1991).

Point C in Figure 2.2 is the representation of point (H_1, K_1, L_1) in the endowment triangle and is characterised by its coordinates (α, β). The ratio of L to H equals the ratio of distance BC to BD. This can be seen as follows. From the previous discussion it is clear that the distance BC is positively related to β. In addition, the endowment triangle is an equilateral triangle and therefore distance BD is positively related to $(1 - \alpha)$. As a result the ratio of L to H is:

$$\frac{\beta}{1-\alpha} = \frac{L_1 \cdot c}{1 - K_1 \cdot c} \quad \text{with} \quad c = \frac{1}{H_1 + K_1 + L_1} \tag{2.25}$$

$$\Rightarrow \frac{\beta}{1-\alpha} = \frac{L_1}{L_1 + H_1} \tag{2.26}$$

Any other point (H_1, K_1^*, L_1) with a different capital endowment, but with the same labour endowments as the original point (H_1, K_1, L_1) will be represented by a point on the AK-line. This is one of the features of

equilateral triangles.

A feature of the endowment triangle is that every point on the line BD has the same relative amount of factor K, but different combinations of H and L. This can easily be deduced by combining the previous discussion of the two-dimensional coordinates of point C and the assumption that $K_1 \cdot c = \alpha$ is constant.

Jones (1992) shows that it is possible to distinguish different regions within the endowment triangle by means of these features. Moreover, by normalising world endowment coordinates with respect to capital (K), skilled (H) and less-skilled labour (L), the world endowment point would be in the centre of the triangle. As shown in Figure 2.3 six different lines can be put through this point. Three of these lines are parallel to the three edges of the triangle, whereas the other three lines emanate from a vertex and go through the world endowment point. As a result the endowment triangle is divided in twelve regions.

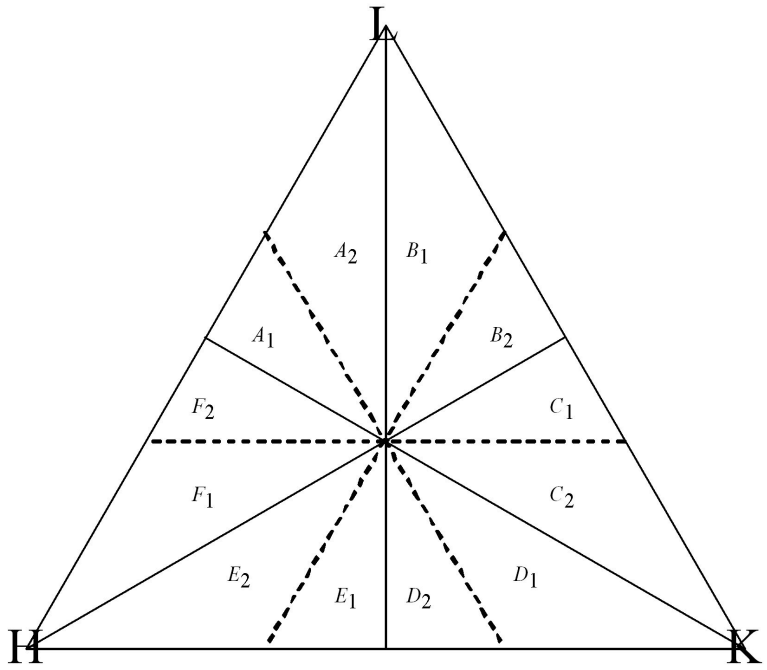

Figure 2.3: The different regions within the endowment triangle

These regions all have different properties, as following discussion will show. Consider the relative world endowment with respect to skilled

and less-skilled labour. Due to the design of the endowment triangle countries with an endowment point within regions A_1, A_2, B_1, B_2, C_1 and C_2 have a higher less-skilled labour to skilled labour ratio than the world. Analogously, it is obvious that the ratio of skilled labour to capital is higher than the world endowment in regions E_1, E_2, F_1, F_2, A_1 and A_2 and that the ratio of less-skilled labour to capital is higher than the world endowment in regions F_1, F_2, A_1, A_2, B_1 and B_2. Therefore regions A_1 and A_2 are rather similar. Countries with an endowment point in one of these regions have a relatively rich less-skilled labour endowment with respect to skilled labour as well as capital. Simultaneously, these countries are, relative to capital, skilled labour abundant. The difference between regions A_1 and A_2 is based upon factor H. As argued by Jones (1992) and shown previously, the line that divides region A_1 from region A_2 is parallel to line LK and region A_1 is thus skilled labour abundant relative to the world, whereas region A_2 is characterised by skilled labour scarcity. Analogously, it is easy to show that the two regions are labour abundant and capital scarce relative to the world. This leads to the conclusion that although the regions are similar, in countries with an endowment point in region A_1 only capital is a scarce factor, whereas endowment points in region A_2 indicate both skilled labour and capital scarcity relative to the world. In conclusion the twelve regions distinguish between different forms of scarcity with respect to the world endowment.

2.5 Country Endowments

At this point it is necessary to make an educated guess with respect to the endowment of South Africa, the EU and China. The first restriction is the limited availability of comparable data on these three countries with respect to both the skill level of labour and capital stock, as well as to the period which is considered in this analysis. Based upon statistics of the International Labour Organization (2010) labour data classified by occupation were retrieved for the year 2005. Since different occupational classes were available, data were aggregated. The skilled labour aggregate comprises classes 01 (legislators, senior officials and managers), 02 (professionals) and 03 (technicians and associate professionals), whereas the less-skilled labour aggregate envelops occupations of classes 04 (clerks), 05 (service workers and shop and market sales workers), 06 (skilled agricultural and fishery workers), 07 (craft and related trade workers), 08 (plant and machine operators and assemblers) and 09 (elementary occupations). This distinction does not correspond entirely with the classifi-

cation of skilled and less-skilled labour in the previous chapter. This is on the one hand due to the fact that two different databases are used, which use different aggregated classifications of labour. By comparison of the two databases it can be shown that the definition of skilled labour in the previous chapter comprises only classes 01 and 02. On the other hand, the ILO database reports data concerning classes 02 and 03 as one aggregate for China. Although there is thus a difference between these classifications, these differences do not result in inconsistent results. Furthermore, it should be noted that EU-data do not include labour data on Luxembourg. This is, however, a minor problem, since Luxembourg does not have a great impact on the European aggregate.

	Skilled Labour	Less-Skilled Labour	Capital
South Africa	2,642,000	9,638,000	N.A.
China	49,298,980	619,007,180	N.A.
EU	78,805,515	129,246,125	N.A.
World	130,746,495	757,891,305	N.A.
Normalised	Skilled Labour	Less-Skilled Labour	Capital
South Africa	2.02%	1.27%	5.00%
China	37.71%	81.67%	40.00%
EU	60.27%	17.05%	55.00%
World	100.00%	100.00%	100.00%

Table 2.1: Educated guess concerning endowments

The collecting of comparable capital stock data is much more complicated. Whereas newer versions of the Penn World Table (Heston et al., 2009) do not report on capital stock data, the older version (Heston et al., 1995) lacks these data for both South Africa and China. Due to the difficulty to obtain such data on the one hand and the consideration that this chapter still discusses a theoretical model on the other hand, the distribution of capital is based upon an educated guess. Table 2.1 shows the result of this approach. Based upon the distribution of skilled and less-skilled labour it can be argued that China has a high less-skilled labour endowment and the European economy is rich in skilled labour. Therefore, the assumption can be made that South Africa is characterised by capital abundance. This means that the share of capital is higher than both the share of skilled and less-skilled labour. For the EU as well as China it is assumed that the capital share is between the share of skilled and less-skilled labour. With respect to Table 2.1 note that the world is

defined as the sum of the EU, China and South Africa.

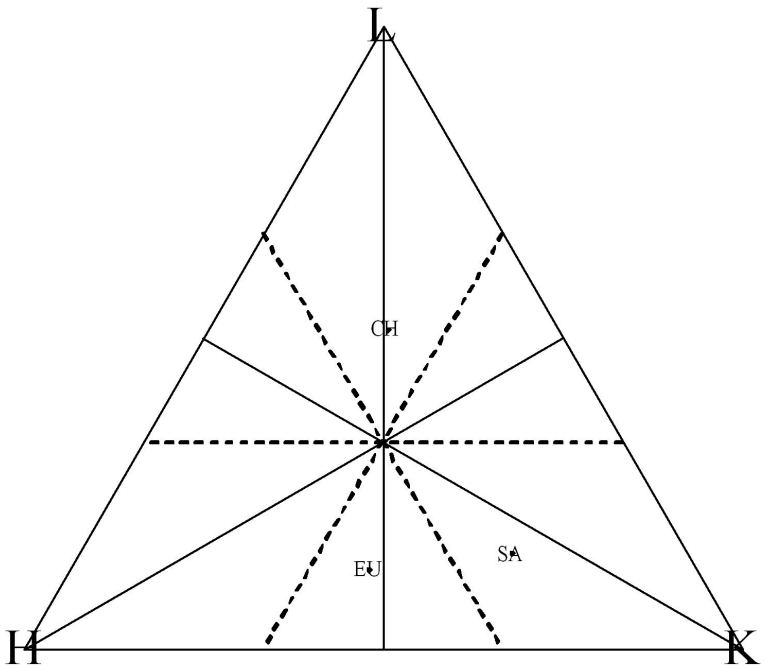

Figure 2.4: Assumptions concerning the endowments of the countries

Based upon these assumptions, it is now possible to plot the endowment of the three regions in the endowment triangle. In Figure 2.4 the endowment point of the world lies in the centre of the endowment triangle. Moreover, if the characteristics of the different regions in the endowment triangle are being considered, some claims can be made. The EU is the only country in which only one factor is scarce. In this case it is assumed that less-skilled labour is a scarce factor within the EU. In the other two countries two factors are scarce. Whereas skilled labour is a scarce factor in both China and South Africa, capital is scarce in China and less-skilled labour is scarce in South Africa. Although most results are not surprising, the claim that less-skilled labour is a scarce factor in South Africa may be counter intuitive. Especially if one is familiar with the South African labour market statistics, which show a high degree of unemployment amongst less-skilled workers, this result seems to make no sense. What look like a contradiction can, however, easily be explained. The educated guess is based upon employment data of the ILO, therefore unemployed individuals drop out of this analysis. Moreover, the world is defined as the sum of only three countries, which can also be a source for

this bias. This approach may seem awkward, but this chapter focusses on the theoretical model in which factor full employment is assumed. In the following chapters the model will be adjusted and unemployment can be considered, but for now this social and economic problem is excluded from the analysis and thus also from the educated guess.

The concept of the endowment triangle can also be applied with respect to sectoral input coordinates. In the following section this will be treated thoroughly.

2.6 Triangles of Diversification

The concept of the endowment triangle can also be applied to represent the three-dimensional input coefficients of industries. The position of these industries in the endowment triangle is variable, since they are defined by their production technology and by the equilibrium conditions of prices and wages. Since the three-dimensional model allows an industry to use either one or two production factors intensively, this distinction will also be discussed in this section.

If each industry uses only one production factor intensively, they will be represented by a point in a specific area in the endowment triangle. If for example production in industry *1* is skilled labour intensive (H), than it can be represented by a point in region E_1, E_2, F_1 or F_2 of Figure 2.3. Analogously, industry *2* will lie in region C_1, C_2, D_1 or D_2 if capital (K) is used intensively in this industry. In region A_1, A_2, B_1 or B_2 industry *3* will be placed, if its production technique is less-skilled labour (L) intensive. These properties can easily be shown by means of the used definition of factor intensity. For example for industry *1* following inequality holds:

$$\frac{\frac{a_{H1}\cdot w_H}{p_1}}{\frac{w_H\cdot v_H}{Y}} > 1 > \frac{\frac{a_{K1}\cdot w_K}{p_1}}{\frac{w_K\cdot v_K}{Y}} \tag{2.27}$$

$$\frac{\frac{a_{H1}\cdot w_H}{p_1}}{\frac{w_H\cdot v_H}{Y}} > 1 > \frac{\frac{a_{L1}\cdot w_L}{p_1}}{\frac{w_L\cdot v_L}{Y}} \tag{2.28}$$

Remember that by normalising the endowment of the world ($v_H = v_K = v_L = 1$, the world endowment point is centred in the endowment triangle. Therefore, the previous inequalites can be simplified to:

$$a_{H1} > a_{K1} \tag{2.29}$$

$$a_{H1} > a_{L1} \tag{2.30}$$

These coordinates can now be compared with the endowment point and thus the position of industry *1* in the endowment triangle.

$$\frac{a_{L1}}{a_{L1} + a_{H1}} < \frac{v_L}{v_L + v_H} \tag{2.31}$$

$$\frac{a_{L1}}{a_{L1} + a_{K1}} < \frac{v_L}{v_L + v_K} \tag{2.32}$$

Keeping account of these assumptions it is possible to plot the input vectors of the three industries in the endowment triangle. These input vectors construct another triangle within the endowment triangle. This new triangle is generally known as a triangle of diversification and has the property that each country with an endowment point within this triangle will produce a positive amount of goods of all three industries. In addition, as argued by Leamer (1987) and Jones and Marjit (1991), none of the production factors is in this case redundant. In countries outside this triangle of diversification at least one good will not be produced and at least one factor will be party unemployed. Figure 2.5 shows a possible distribution of the three industries within the endowment triangle for which the market clearing condition holds. The combination of factor input vectors is given in Table 2.2. These input vectors satisfy the previously discussed restrictions with respect to factor intensities.

	Skilled Labour (H)	Less-Skilled Labour (L)	Capital (K)
Industry 1	0.80	0.05	0.10
Industry 2	0.05	0.10	0.75
Industry 3	0.15	0.85	0.15

Table 2.2: The input vectors of Figure 2.5

Note that with the same technique it would be easy to define the position of an industry if it uses two production factors intensively. Since, however, Figure 1.4 shows that that is not the case for South Africa, this possibility will not be discussed here. This chapter thus will only treat the case that each industry uses only one production factor intensively

Based upon the work of Leamer (1987), Jones and Marjit (1991) and Jones (1992) the signs within the Stolper-Samuelson matrix (2.7) and

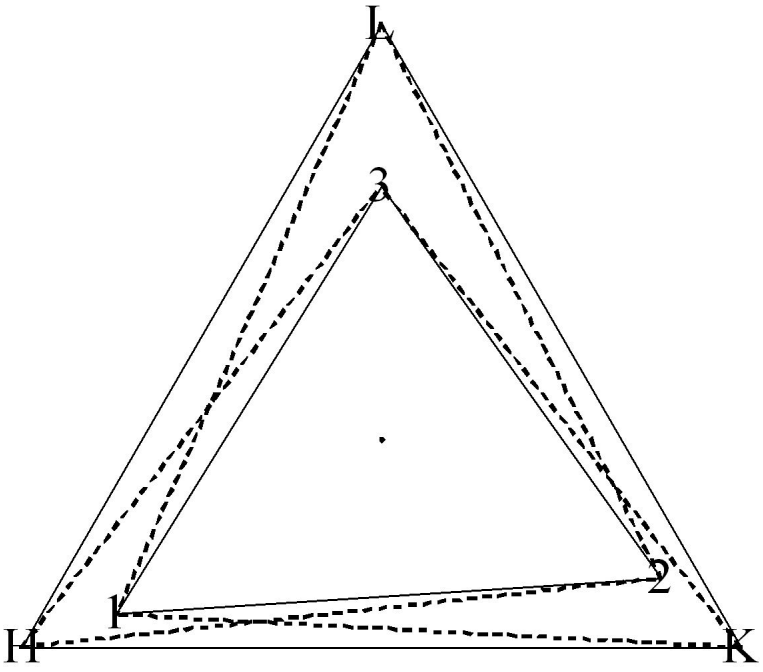

Figure 2.5: Industries in the endowment triangle

the Rybczynski matrix (2.6) can be discussed by means of the triangle of diversification. In Figure 2.5 three cones, each originating in another vertex of the endowment triangle, are plotted. Jones (1992, 4) calls these cones "the *minimal containing cone for factor i*". Due to definition the cone in the skilled labour (H) vertex shows that the less-skilled labour (L) to capital (K) ratio of industry *1* is smaller than this ratio in industry *3* and bigger than this ratio in industry *2*. This cone as well as the other two cones encapsulate two edges of the triangle of diversification. If a cone contains two facing boundaries, as it is the case in Figure 2.5, than an increase of the factor which defines the cone increases the production of the industry which lies on the vertex of these two boundaries. For example an increase in the endowment of skilled labour would increase the production of industry *1*, whereas the production in industry *2* as well as industry *3* would decrease.

With respect to the Rybczynski matrix Figure 2.5 represents only the possibility that the endowment increase of one factor increases the production in the industry which uses this factor intensively and decreases output in the other two industries. This claim can easily be proved. Equation 2.6 shows that the Rybczynski matrix is the inverse of the

input-output matrix A. Moreover, since all principal minors of the input-output matrix are positive, the determinant of A is positive. Furthermore, the elements on the diagonal are a combination of this determinant with the 2x2 principal minors and are thus also positive. Combining this information with the input-output vectors of Figure 2.5 allows the deduction of the signs of the Rybczynski matrix.

$$\frac{\partial x}{\partial v} = A^{-1}$$

$$= \frac{1}{det(A)} \cdot \begin{pmatrix} {}^{a}K2{}^{a}L3 - {}^{a}L2{}^{a}K3 & -{}^{a}K1{}^{a}L3 + {}^{a}L1{}^{a}K3 & {}^{a}K1{}^{a}L2 - {}^{a}L1{}^{a}K2 \\ -{}^{a}H2{}^{a}L3 + {}^{a}L2{}^{a}H3 & {}^{a}H1{}^{a}L3 - {}^{a}L1{}^{a}H3 & -{}^{a}H1{}^{a}L2 + {}^{a}L1{}^{a}H2 \\ {}^{a}H2{}^{a}K3 - {}^{a}K2{}^{a}H3 & -{}^{a}H1{}^{a}K3 + {}^{a}K1{}^{a}H3 & {}^{a}H1{}^{a}K2 - {}^{a}K1{}^{a}H2 \end{pmatrix} \tag{2.33}$$

The signs of the Rybczynski matrix : $\begin{pmatrix} + & - & - \\ - & + & - \\ - & - & + \end{pmatrix}$

With regard to the Stolper-Samuelson matrix, results are similar. An increase in the price of good *1* has a magnified effect on the wage of skilled labour, whereas both the wage of less-skilled labour and the return to capital is reduced. In this situation it is said that industry 1 is an unambiguous friend for skilled labour. If it was again the case that the cone in the skilled labour vertex contains only one edge of the triangle of diversification defined by the input vector of industry *1* and *3*, than a price increase in industry *2* would decrease unambiguously the return to capital. Therefore industry *2* is the unambiguous enemy for capital. In this case the effect on both the wage of skilled and less-skilled labour is not clear. (Jones, 1992)

Similar to the deduction of the signs of the Rybczynski matrix it is also possible to define the signs of the Stolper-Samuelson matrix. Note that the Stolper-Samuelson matrix is, as shown in Equation 2.7, the transpose of the Rybczynski matrix.

$$\frac{\partial w}{\partial p} = (A')^{-1}$$

$$= \frac{1}{det(A')} \cdot \begin{pmatrix} {}^{a}K2{}^{a}L3 - {}^{a}L2{}^{a}K3 & -{}^{a}H2{}^{a}L3 + {}^{a}L2{}^{a}H3 & {}^{a}H2{}^{a}K3 - {}^{a}K2{}^{a}H3 \\ -{}^{a}K1{}^{a}L3 + {}^{a}L1{}^{a}K3 & {}^{a}H1{}^{a}L3 - {}^{a}L1{}^{a}H3 & -{}^{a}H1{}^{a}K3 + {}^{a}K1{}^{a}H3 \\ {}^{a}K1{}^{a}L2 - {}^{a}L1{}^{a}K2 & -{}^{a}H1{}^{a}L2 + {}^{a}L1{}^{a}H2 & {}^{a}H1{}^{a}K2 - {}^{a}K1{}^{a}H2 \end{pmatrix} \tag{2.34}$$

The signs of the Stolper-Samuelson matrix : $\begin{pmatrix} + & - & - \\ - & + & - \\ - & - & + \end{pmatrix}$

By combining the features of the triangles of diversification with the endowment points it is now possible to discuss a three-dimensional trade model that represents the trade relationship between South Africa, the EU and China. Note, however, that this model is a simplification and will be developed further in next chapter.

2.7 The Trade Model

Figure 2.6 combines the endowment points of the three countries with the previously discussed triangle of diversification. Based on this figure it is now possible to discuss trade flows between South Africa, the EU and China.

Since each country's endowment point lies within the triangle of diversification, all three products are produced in each country. Moreover, none of the production factors will be vacant, i.e. factors are fully employed. Since factor price equalisation due to trade is assumed and consumers have homothetic tastes, consumption patterns in each country will be equal to the global consumption pattern. Since the market clearing condition holds on a global level, the consumed amount of the three products equals production. In Figure 2.6 indicators for the produced amounts in the three industries can be deducted. From the previous discussion of the endowment triangle it is straightforward that the endowment point can be represented as a positive combination of the input vectors of the three industries. Now consider line *2'-3'*, which is parallel to the edge *2-3* of the triangle of diversification and goes through the world endowment point. Each point on this line can also be represented as a positive combination of the input vectors of the three industries. Whereas point *2'* is only a combination of the input vectors of industry *1* and industry *2*, point *3'* is a combination of industry *1* and industry *3*. If one keeps in mind that the *2'-3'* line is parallel to the *2-3* line and that the *2-3* line only consists of different combinations of the input vectors of industry *2* and industry *3*, then it is straightforward that each point on the *2'-3'* line has the same amount of the input vector of industry *1*. Therefore, the distance between the *2-3* line and the *2'-3'* line can be used as an indicator for the production of industry *1*.

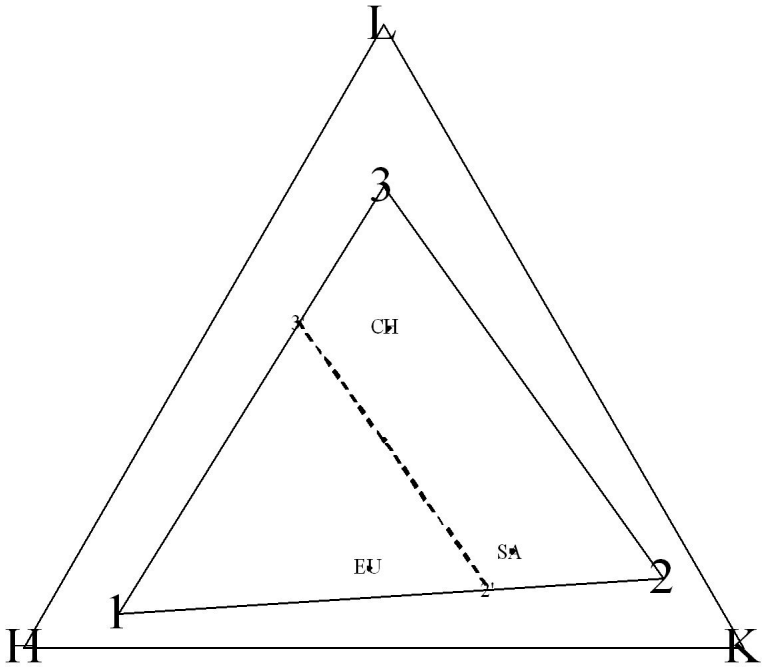

Figure 2.6: Analysing trade flows by means of the endowment triangle

From the previous section it is clear now that the shortest distance between the endowment point and an edge of the triangle of diversification is an indicator for the production in the industry opposite to this edge. Moreover, the relative consumption of these goods can be represented by the production of these products on the global level, due to the market clearing condition. If these two insights are combined and applied to the model represented in Figure 2.6 then following statements can be made:

- The produced amount of good *1* in both South Africa and China falls short of the consumption of this good in these countries. Simultaneously, the production of this good in the EU exceeds consumption of this good in the EU. Therefore the EU exports the skilled labour intensive good to South Africa and China.

- The capital intensive production of good *2* in the EU as well as in South Africa exceeds the consumption of this good in these two countries. The surplus of both countries is exported to China, which has to import product *2* in order to meet its domestic demand.

- Both South Africa and the EU produce a relative small amount of good *3*, whereas China produces more than it consumes. Therefore China exports its surplus of this less-skilled labour intensive product to the EU and South Africa.

In this section it is shown that by combining the insights of the mathematical three-dimensional model with the concept of the endowment triangle and the triangle of diversification it is possible to model trade flows between South Africa, the EU and China. Note, however, that Figure 2.6 is only one imaginable way of representing the factor endowments and factor intensities. Other constructions with similar trade flows are possible. The next section discusses the difference between the autarkic case and free trade with respect to South Africa.

2.8 Autarchy vs. Free Trade

To conclude this chapter the equilibrium condition in the autarkic situation is compared with the equilibrium condition under free trade for the specific case of South Africa. Unfortunately, this is not possible without specifying production functions as well as a consumption function. Therefore, this section starts with a discussion of these functions. Based on these functions it will be possible to treat the change of input vectors in South Africa in the wake of trade liberalisation. Moreover, changes in factor remuneration can be analysed. This section ends with the comparison of output levels under autarchy and under free trade. With the same approach it is also feasible to discuss changes within the EU and China, which will, however, not be discussed in this thesis. Based on this comparative statics some general claims can be made about the theoretical advantages of free trade.

2.8.1 Specifying production and utility functions

One function that complies with the assumed requirements of the production function is the Cobb-Douglas production function. The Cobb-Douglas production function has following mathematical equation:

$$x_j = B_j \prod_i \left(v_{ij}^{\rho_{ij}}\right) \tag{2.35}$$

$$\text{with} \quad i = K, H, L \quad , \quad j = 1, 2, 3 \quad \text{and} \quad \sum_i \rho_{ij} = 1$$

The Cobb-Douglas production function is not only homogeneous of the first order, but is also smooth and its marginal return diminishes for each production factor. Moreover, since the sum of the output elasticities (ρ) within one industry equals unity, constant returns to scale are assumed. These production functions can now be combined with a Cobb-Douglas utility function (U), which defines consumer demand.

$$U = \prod_j \left(x_j^{\delta_j}\right) \quad \text{with} \quad j = 1,2,3 \quad \text{and} \quad \sum_j \delta_j = 1 \tag{2.36}$$

Based on these general functions the equilibrium of on autarkic economic system can be calculated. For this purpose the Lagrange multiplier (λ) is used. Applying this technique yields following results:

$$p_1\lambda = \frac{\delta_1}{x_1} x_1^{\delta_1} x_2^{\delta_2} x_3^{\delta_3} \Rightarrow \lambda = \frac{\delta_1}{x_1 p_1} x_1^{\delta_1} x_2^{\delta_2} x_3^{\delta_3} \tag{2.37}$$

$$p_2\lambda = \frac{\delta_2}{x_2} x_1^{\delta_1} x_2^{\delta_2} x_3^{\delta_3} \Rightarrow \lambda = \frac{\delta_2}{x_2 p_2} x_1^{\delta_1} x_2^{\delta_2} x_3^{\delta_3} \tag{2.38}$$

$$p_3\lambda = \frac{\delta_3}{x_3} x_1^{\delta_1} x_2^{\delta_2} x_3^{\delta_3} \Rightarrow \lambda = \frac{\delta_3}{x_3 p_3} x_1^{\delta_1} x_2^{\delta_2} x_3^{\delta_3} \tag{2.39}$$

By assuming that p_1 is a *numéraire*, i.e. $p_1 = 1$, relative prices of commodity 2 and commodity 3 can be calculated with respect to this *numéraire*.

$$\frac{p_2}{p_1} = \frac{x_1\delta_2}{x_2\delta_1} \tag{2.40}$$

$$\frac{p_3}{p_1} = \frac{x_1\delta_3}{x_3\delta_1} \tag{2.41}$$

Moreover, Equation 2.4 can be used to yield expressions for the elements of the input-output matrix (A).

$$\frac{w_i}{p_j} = \frac{\rho_{ij}}{v_{ij}} B_j \prod_i \left(v_{ij}^{\rho_{ij}}\right)$$

$$\Rightarrow \frac{w_i}{p_j} = \frac{\rho_{ij}}{v_{ij}} x_j$$

$$\Rightarrow a_{ij} = \frac{v_{ij}}{x_j} = \rho_{ij} \frac{p_j}{w_i} \tag{2.42}$$

This expression for the elements of the input-output matrix can be combined with the definition of factor intensity and with the assumptions concerning factor intensities within each industry. As a result the relationship between the output elasticities (ρ) can be deduced. For example for the skilled labour factor following inequality can be derived:

$$\frac{\frac{a_{H1}\cdot w_H}{p_1}}{\frac{w_H\cdot v_H}{Y}} > 1 > \frac{\frac{a_{H2}\cdot w_H}{p_2}}{\frac{w_H\cdot v_H}{Y}}$$

$$\Rightarrow \frac{\frac{\rho_{H1}\frac{p_1}{w_H}\cdot w_H}{p_1}}{\frac{w_H\cdot v_H}{Y}} > 1 > \frac{\frac{\rho_{H2}\frac{p_2}{w_H}\cdot w_H}{p_2}}{\frac{w_H\cdot v_H}{Y}}$$

$$\Rightarrow \rho_{H1} > \rho_{H2} \tag{2.43}$$

$$\frac{\frac{a_{H1}\cdot w_H}{p_1}}{\frac{w_H\cdot v_H}{Y}} > 1 > \frac{\frac{a_{H3}\cdot w_H}{p_3}}{\frac{w_H\cdot v_H}{Y}}$$

$$\Rightarrow \frac{\frac{\rho_{H1}\frac{p_1}{w_H}\cdot w_H}{p_1}}{\frac{w_H\cdot v_H}{Y}} > 1 > \frac{\frac{\rho_{H3}\frac{p_3}{w_H}\cdot w_H}{p_3}}{\frac{w_H\cdot v_H}{Y}}$$

$$\Rightarrow \rho_{H1} > \rho_{H3} \tag{2.44}$$

Analogously following inequalities can be deduced:

$$\rho_{K2} > \rho_{K1} \tag{2.45}$$

$$\rho_{K2} > \rho_{K3} \tag{2.46}$$

$$\rho_{L3} > \rho_{L1} \tag{2.47}$$

$$\rho_{L3} > \rho_{L2} \tag{2.48}$$

Moreover, it is assumed that the global factor price equalisation holds. This means that all principal minors of the input-output coefficient matrix (A) are positive. (Takayama, 1981) Whereas the previous inequalities are sufficient to show that the first minor as well as the second minors are positive, with respect to the third minor, i.e. the determinant of the input-output coefficient matrix (A), another condition should be imposed. Therefore, it is assumed that:

$$\rho_{H1}\left(\rho_{K2}-\rho_{K3}\right)+\rho_{H3}\left(\rho_{K1}-\rho_{K2}\right)+\rho_{H2}\left(\rho_{K3}-\rho_{K1}\right)>0 \tag{2.49}$$

With this basic information it is possible to analyse the effects of trade liberalisation with respect to input vectors, factor remunerations, commodity prices and output in the South African economy. The next subsections will discuss these topics thoroughly.

2.8.2 The change of input vectors

Since both South Africa as an independent entity as well as South Africa as part of the world fulfil the assumptions formulated at the beginning of this chapter, it is possible to compare equilibria in these two situations. In a first approach input vectors will be compared. By combining Equations 2.40, 2.41 and 2.8.1 with the market clearing condition expressions can be found for the input vectors. These input vectors are defined as a function of the original factor endowment (v_i).

$$v_{ij} = \frac{v_i \delta_j \rho_{ij}}{\sum_j (\delta_j \rho_{ij})} \tag{2.50}$$

Equation 2.50 allows a comparison of the South African input vectors under autarchy and in the free trade situation. In the following analysis index SA is used to describe the coefficient of the autarkic South Africa and index W is used to describe the coefficients of South Africa integrated in the world economy. It is straightforward to see that following ratios are identical:

$$\frac{v_{ij}^{SA}}{v_{ij}^{W}} = \frac{v_i^{SA}}{v_i^{W}} \tag{2.51}$$

By including the information of Figure 2.4 to this analysis following inequalities can be deducted:

$$\frac{v_{Hj}^{SA}}{v_{Lj}^{SA}} > \frac{v_{Hj}^{W}}{v_{Lj}^{W}} \tag{2.52}$$

$$\frac{v_{Kj}^{SA}}{v_{Lj}^{SA}} > \frac{v_{Kj}^{W}}{v_{Lj}^{W}} \tag{2.53}$$

$$\frac{v_{Kj}^{SA}}{v_{Hj}^{SA}} > \frac{v_{Kj}^{W}}{v_{Hj}^{W}} \tag{2.54}$$

This analysis thus shows that within the three industries production will be relatively more capital intensive with respect to skilled as well as less-skilled labour, if the South African economy is closed. Moreover, the ratio of skilled labour to less-skilled labour in each industry will be higher in this situation. The implication of this shift with respect to output levels will be discussed later, in the next step the change of factor remuneration is analysed.

2.8.3 Factor remuneration

The inequalities deducted in the previous section are now used to compare factor remuneration in two different situations. The basis of this analysis is once again Equation 2.8.1. By means of this equation it is possible to define relative factor remuneration as a function of the input vectors and thus as function of the original factor endowment (v_i). As already discussed in this chapter it is assumed that the factor price equalisation theorem holds and therefore relative factor remunerations in South Africa will equal those of the world economy, if the South African economy is integrated in the world economy. These relative factor remunerations can be compared with those of the closed South African economy. This yields following results:

$$\frac{w_L}{w_H} = \frac{\delta_{Lj}}{\delta_{Hj}} \frac{v_{Hj}}{v_{Lj}}$$

$$\Rightarrow \frac{\frac{w_L^{SA}}{w_H^{SA}}}{\frac{w_L^W}{w_H^W}} = \frac{\frac{v_{Hj}^{SA}}{v_{Lj}^{SA}}}{\frac{v_{Hj}^W}{v_{Lj}^W}} = \frac{\frac{v_H^{SA}}{v_L^{SA}}}{\frac{v_H^W}{v_L^W}}$$

$$\Rightarrow \frac{w_L^{SA}}{w_H^{SA}} > \frac{w_L^W}{w_H^W} \tag{2.55}$$

$$\frac{w_L}{w_K} = \frac{\delta_{Lj}}{\delta_{Kj}} \frac{v_{Kj}}{v_{Lj}}$$

$$\Rightarrow \frac{\frac{w_L^{SA}}{w_K^{SA}}}{\frac{w_L^W}{w_K^W}} = \frac{\frac{v_{Kj}^{SA}}{v_{Lj}^{SA}}}{\frac{v_{Kj}^W}{v_{Lj}^W}} = \frac{\frac{v_K^{SA}}{v_L^{SA}}}{\frac{v_K^W}{v_L^W}}$$

$$\Rightarrow \frac{w_L^{SA}}{w_K^{SA}} > \frac{w_L^W}{w_K^W} \tag{2.56}$$

$$\frac{w_H}{w_K} = \frac{\delta_{Hj}}{\delta_{Kj}} \frac{v_{Kj}}{v_{Hj}}$$

$$\Rightarrow \frac{\frac{w_H^{SA}}{w_K^{SA}}}{\frac{w_H^W}{w_K^W}} = \frac{\frac{v_{Kj}^{SA}}{v_{Hj}^{SA}}}{\frac{v_{Kj}^W}{v_{Hj}^W}} = \frac{\frac{v_K^{SA}}{v_H^{SA}}}{\frac{v_K^W}{v_H^W}}$$

$$\Rightarrow \frac{w_H^{SA}}{w_K^{SA}} > \frac{w_H^W}{w_K^W} \tag{2.57}$$

This analysis shows that less-skilled labour will experience a relative wage reduction with respect to skilled labour and capital due to trade liberalisation. Moreover, the remuneration of skilled labour relative to capital will also decrease in the wake of trade liberalisation.

2.8.4 Prices

A comparison of relative prices is possible by using the equilibrium Equations 2.40, 2.41 and 2.8.1. This results in following equations:

$$\frac{p_2}{p_1} = \frac{B_1 \left(\frac{v_{H1}}{v_{L1}}\right)^{\rho_{H1}} \left(\frac{v_{K1}}{v_{L1}}\right)^{\rho_{K1}\rho_{L1}}}{B_2 \left(\frac{v_{H2}}{v_{L2}}\right)^{\rho_{H2}} \left(\frac{v_{K2}}{v_{L2}}\right)^{\rho_{K2}} \rho_{L2}} \tag{2.58}$$

$$\frac{p_3}{p_1} = \frac{B_1 \left(\frac{v_{H1}}{v_{L1}}\right)^{\rho_{H1}} \left(\frac{v_{K1}}{v_{L1}}\right)^{\rho_{K1}} \rho_{L1}}{B_3 \left(\frac{v_{H3}}{v_{L3}}\right)^{\rho_{H3}} \left(\frac{v_{K3}}{v_{L3}}\right)^{\rho}_{K3} \rho_{L3}} \tag{2.59}$$

$$\frac{p_2}{p_3} = \frac{B_3 \left(\frac{v_{H3}}{v_{L3}}\right)^{\rho}_{H3} \left(\frac{v_{K3}}{v_{L3}}\right)^{\rho_{K3}} \rho_{L3}}{B_2 \left(\frac{v_{H2}}{v_{L2}}\right)^{\rho_{H2}} \left(\frac{v_{K2}}{v_{L2}}\right)^{\rho_{K2}} \rho_{L2}} \tag{2.60}$$

These equations can be simplified by substituting relative input factors with relative factor endowments according to Equation 2.51. This yields following results:

$$\frac{p_2}{p_1} = \frac{B_1 \rho_{L1}}{B_2 \rho_{L2}} \left(\frac{v_H}{v_L}\right)^{\rho_{H1}-\rho_{H2}} \left(\frac{v_K}{v_L}\right)^{\rho_{K1}-\rho_{K2}} \tag{2.61}$$

$$\frac{p_3}{p_1} = \frac{B_1 \rho_{L1}}{B_3 \rho_{L3}} \left(\frac{v_H}{v_L}\right)^{\rho_{H1}-\rho_{H3}} \left(\frac{v_K}{v_L}\right)^{\rho_{K1}-\rho_{K2}} \tag{2.62}$$

$$\frac{p_2}{p_3} = \frac{B_3 \rho_{L3}}{B_2 \rho_{L2}} \left(\frac{v_H}{v_L}\right)^{\rho_{H3}-\rho_{H2}} \left(\frac{v_K}{v_L}\right)^{\rho_{K3}-\rho_{K2}} \tag{2.63}$$

Now the relative prices of a closed South African economy can be compared with those of a globalised economy. Whereas both the results of a comparison of p_1/p_2 and of a comparison of p_1/p_3 cannot be determined, the comparison of p_2/p_3 yields an unambiguous result.

$$\frac{\frac{p_2^{SA}}{p_3^{SA}}}{\frac{p_2^W}{p_3^W}} = \left(\frac{\frac{v_H^{SA}}{v_L^{SA}}}{\frac{v_H^W}{v_L^W}}\right)^{\rho_{H3}-\rho_{H2}} \left(\frac{\frac{v_K^{SA}}{v_L^{SA}}}{\frac{v_K^W}{v_L^W}}\right)^{\rho_{K3}-\rho_{K2}} \tag{2.64}$$

$$\Rightarrow \frac{\frac{p_2^{SA}}{p_3^{SA}}}{\frac{p_2^W}{p_3^W}} = \left(\frac{\frac{v_H^{SA}}{v_L^{SA}}}{\frac{v_H^W}{v_L^W}}\right)^{\rho_{L3}-\rho_{L2}} \left(\frac{\frac{v_K^{SA}}{v_H^{SA}}}{\frac{v_K^W}{v_H^W}}\right)^{\rho_{K3}-\rho_{K2}} \tag{2.65}$$

By including the information of the relative factor endowments, which are displayed in Figure 2.4 and Inequalities 2.48 and 2.46, following statement can be made:

$$\frac{p_2^{SA}}{p_3^{SA}} < \frac{p_2^W}{p_3^W} \tag{2.66}$$

Thus, trade liberalisation in South Africa causes the relative price of commodity 2 with respect to commodity 3 to increase. Since Equations 2.40 and 2.41 establish a link between relative prices and relative output, the insights offered by Inequality 2.66 also imply that the relative output of industry 3 with regard to industry 2 is higher in the world economy than it is in an autarkic South Africa. The shift of output levels within South Africa will be discussed in the next subsection.

2.8.5 South African output levels

The change in output levels due to trade liberalisation can be deduced by means of the relative input vectors, the change thereof due to trade liberalisation and Figure 2.6. Since the previous analysis shows that the production of the three industries in an autarkic South Africa will be more capital intensive with respect to less-skilled labour as well as skilled labour and that the autarkic production is also more skilled labour intensive with respect to less-skilled labour, a new triangle of diversification can be drawn. Moreover, it is possible to calculate these input vectors, since following equations are known:

$$\frac{v_{Hj}^{SA}}{v_{Lj}^{SA}} = \frac{v_{Hj}^W}{v_{Lj}^W}\frac{v_H^{SA}}{v_L^{SA}}\frac{v_H^W}{v_L^W} \tag{2.67}$$

$$\frac{v_{Kj}^{SA}}{v_{Lj}^{SA}} = \frac{v_{Kj}^W}{v_{Lj}^W}\frac{v_K^{SA}}{v_L^{SA}}\frac{v_K^W}{v_L^W} \tag{2.68}$$

$$\frac{v_{Kj}^{SA}}{v_{Hj}^{SA}} = \frac{v_{Kj}^W}{v_{Hj}^W}\frac{v_K^{SA}}{v_H^{SA}}\frac{v_K^W}{v_H^W} \tag{2.69}$$

Table 2.3 shows the results of combing these equations with the information of Table 2.1 and Table 2.2. These input vectors are visualised in

Figure 2.7. Triangle $1^W - 2^W - 3^W$ is the triangle of diversification that emerges due to free trade, whereas triangle $1^{SA} - 2^{SA} - 3^{SA}$ represents the triangle of diversification for the autarkic South African economy.

Industry	Skilled Labour (H)	Less-Skilled (L)	Capital (K)
Industry 1	72.55	2.85	22.45
Industry 2	0.28	0.35	10.30
Industry 3	27.17	96.80	67.25

Table 2.3: The input vectors for an autarkic South African economy

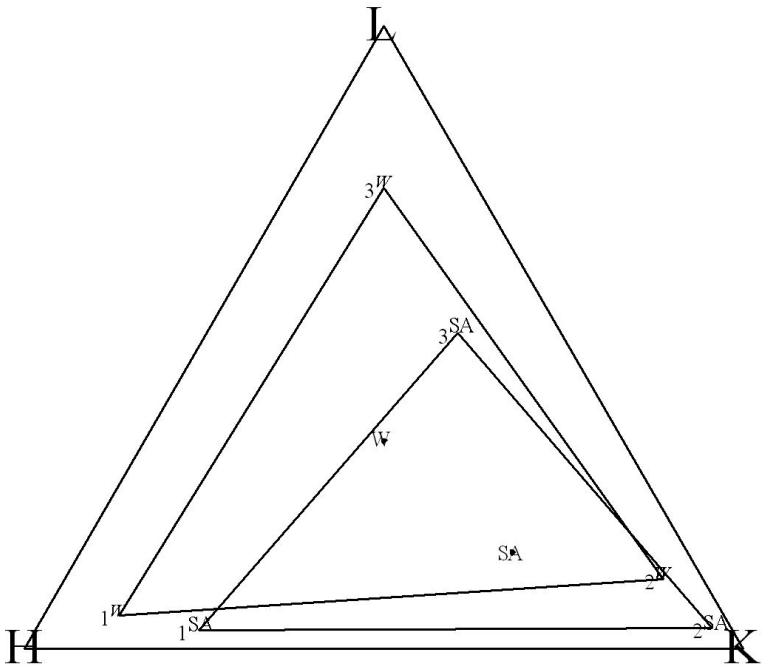

Figure 2.7: Comparison of output levels: autarchy-free trade

Since the autarkic production is more capital intensive both with respect to less-skilled as well as skilled labour, edge $1^{SA}-2^{SA}$ will always lie below edge 1^W-2^W. Based upon the properties of the endowment triangle and the triangle of diversification it can be stated that the output of industry 3 will be higher if South Africa is self-sufficient. Similar it is easy to show that edge $1^{SA} - 3^{SA}$ lies closer to the endowment point SA than edge 1^W-3^W. With regard to output levels this means that the production of

industry 2 will be less in the autarkic situation. With respect to industry 1 no clear statement can be made about the change in output.

2.9 Conclusion

In order to model the South African trade structure with both the EU and China it is necessary to extend the two-dimensional Heckscher-Ohlin trade model. Unfortunately, the introduction of a third dimension does not yield straightforward mathematical results and therefore appears to have little practical use. However, as shown in this chapter the concepts of the endowment triangle and the triangles of diversification make the three-dimensional trade model usable again. By means of this method the possible impact of trade liberalisation on the South African production structure and factor remuneration can be discussed on a theoretical base.

To discuss changes in the South African economy due to trade liberalisation Cobb-Douglas consumption and production functions were introduced. Within this framework it is shown that both skilled and less-skilled labour experience negative effects from this liberalisation. Whereas the remuneration of these labour factors decreases with respect to the remuneration of capital, less-skilled labour loses also with respect to skilled labour. Simultaneously, the relative price of the capital intensive commodity with respect to the labour intensive commodity increases. In addition, the three-country world produces relatively more of the labour intensive good with regard to the capital intensive product than the closed South African economy. Furthermore, it was shown that trade liberalisation prompts the South African economy to increase the production of the capital intensive industry, whereas the output of the less-skilled labour intensive industry is reduced. Due to the multidimensionality of the model the output change of the skilled labour intensive industry is undefined.

Without any doubt the attentive reader did notice that with the same technique similar trade flows can be modelled. Unfortunately, a thorough discussion of the concept of the endowment triangle and peculiar positions within this triangle would go beyond the scope of this thesis. The main aim of this chapter was to display a general trade model which explains the South African import and export structure with respect to both the EU and China. In the following chapter a link between the South African labour market and this trade model is elaborated. Within

that framework the model will be further adapted.

The title of this chapter refers to the fact that by means of the endowment triangle it is possible to make statements about trade flows. Similar to the dial of a clock, the endowment triangle visualises these trade flows as differences between the production point and the consumption point. At the same time these trade flows are a result from the application of the general equilibrium theory, in which all components of an economy are tightly intertwined and influence each other reciprocally. The change of one component influences the overall equilibrium. These multidimensional and reciprocal interactions are similar to the wheels of a mechanical clockwork.

Chapter 3

Working it out?

3.1 Introduction

Whereas the previous chapters discussed the trade structure of the South African economy on both an empirical and a theoretical level, this chapter analyses employment and unemployment in South Africa on both levels. Until now the social and economic reality of unemployment in South Africa has been neglected in the analysis. Considering the fact that around 40% of the labour force was unemployed in 2005, the previous theoretical debate has to be adjusted. Therefore, a descriptive analysis of the South African labour market is needed to find possible distortions which can explain this high level of unemployment. This chapter focusses explicitly on these issues.

With respect to the labour market one should consider the transition that took place between the apartheid regime and the post-apartheid era. Therefore, this chapter starts with an analysis of this transition and its effect on the labour market. Based on the work of Von Holdt and Webster (2005) this transition is regarded as a triple transition. Since this historical period is also considered as a negotiated revolution it is not sufficient to focus only on the economic changes that took place. Besides this aspect social as well as political changes also have to be discussed. This approach has the advantage that the workplace can be embedded in its social context.

Following this analysis, which offers a general background of the South African economy and its labour market, the second section takes a closer look at employment trends between 1993 and 2006. In this section only

those industries which were also treated in the first chapter are discussed. This section not only describes general trends with respect to employment, but also distinguishes between formal and informal employment. Formal employment in its turn breaks down into highly skilled, skilled, and semi- and unskilled labour. These distinctions allow to include insights from previous sections. The general observation is that employment decreased or was stagnant in most sectors.

The third section discusses different explanations for this trend of stagnating employment. For this purpose it refers to different academic literature and discusses different hypotheses offered by this literature. An expected effect of stagnating employment would be unemployment. As a matter of fact unemployment did increase since 1994 in South Africa. Given that this subject is complicated it is treated separately in the fourth section.

This fifth and last section of this chapter sums up the main insights of the previous sections. Based upon this information it is argued that some labour market rigidities exist in the South African economy. Moreover, these rigidities can be simplified to a binding minimum wage. Before introducing this wage into the three-dimensional trade model a brief literature overview is given of scholars who implemented such a wage in a two-dimensional Heckscher-Ohlin trade model. Furthermore, the endowment triangle is adjusted to show the extent of unemployment which is discussed. Afterwards the changes in the theoretical model due to the binding minimum wage are displayed. In a last step the impact of trade liberalisation on the (un)employment level of less-skilled labour is treated.

3.2 South Africa's Social Context

This chapter uses a comprehensive approach based upon the work of Von Holdt and Webster (2005) to describe the restructuring of the labour market that happened since 1994. This enables to embed the South African labour market in its social context, i.e. the important relationship between labour markets and society is highlighted. As argued by the authors the end of apartheid can be regarded as a triple transition: a political transition, an economic transition and a social transition. Since these transitions construct the background of the labour market restructuring, they will be briefly discussed.

The political transition is marked by the end of authoritarianism and the introduction of democracy. As noted by Von Holdt and Webster (2005), this transition did not only empower all citizens, but provided also democratic and social rights to trade unions and workers. The new government, consisting of a tripartite alliance of the African National Congress (ANC), the South African Communist Party (SACP) and the Congress of South African Trade Unions (COSATU), acted with caution to build an industrial relations climate, which was non-adversarial. Similar to the negotiation of the trade policy, labour policy is based on the principles of consensus and cooperative governance. One example of trilateral participation between state, business and labour is the National Economic Development and Labour Council (NEDLAC), which was established in 1995. (Bhorat et al., 2002, Braude, 2005) With respect to the regulatory framework four labour acts are especially worth mentioning. The Labour Relations Act of 1995 (LRA) introduced bargaining councils and other dispute resolution institutions (e.g. the Commission for Conciliation, Mediation and Arbitration, the Labour Court and the Labour Appeal Court). Moreover, the LRA guarantees and regulates the right to strike. Besides the objectives of social justice and labour peace, the act seeks to democratise the workplace and to promote economic development. (Bhorat et al., 2002, Braude, 2005) The second act is the Basic Conditions of Employment Act of 1997 (BCEA) and introduces minimum standards of employment. In theory the BCEA ensures all employees (also unorganised, non-standard and vulnerable workers) core rights such as hours of work, workplace protection and different leaves (e.g. sick leave, maternity leave, etc.). However, a certain level of flexibility is maintained due to the collective bargaining system and sectoral determinations. (Bhorat et al., 2002, Braude, 2005) The Employment Equity Act of 1998 (EEA) has the aim to promote employment equity. Whereas the apartheid era was characterised by racial discrimination and authoritarian management, new labour policy is keen to overcome past discrimination and labour market disadvantages. The EEA effects a broad range of employment practice such as: recruitment, remuneration, etc. (Bhorat et al., 2002, Braude, 2005) The Skills Development Act of 1998 (SDA) aims at strengthening the link between education and economic growth. During the apartheid era the majority of employees received poor education and are now less-qualified. The SDA aims at increasing the qualification of less-skilled workers by means of workplace education and training. (Bhorat et al., 2002, Braude, 2005) The polit-

ical transition, which was accompanied by new labour legislation, had doubtlessly a major impact on the workplace.

The economic transition that took place can be best described as a reorientation of the economy. Whereas the apartheid growth model and international sanctions against the apartheid government resulted in an inward oriented economy, the economic policy of the new democratic government was more outward oriented. During the apartheid era industrial and trade policy was characterised by import-substitution industrialisation and by the integration of South Africa as mineral exporter within the international division of labour. Whereas the mining and mineral industries were mainly export oriented, manufacturing industries found an attractive domestic market due to high import tariffs. Moreover, the supply of cheap labour had a key role in the industry policy. (Nattrass, 1992) This growth strategy, however, reached its boundaries at the end of the 1970s and was since then in permanent crisis. To make matters worse, the new government faced not only this challenging responsibility, but saw itself confronted with a stressed budget situation. During the beginning of the 1990s the apartheid government practised excessive deficit spending resulting in high levels of fiscal deficit and government debt. As cited by Gelb (2005, 370) the fiscal deficit of the exit government increased from 1.4% of GDP in 1991 to 10.1% in 1993 and government debt increased from 29.0% of GDP in 1990-91 to 48% in 1995-96. Under these conditions the ANC, which envisaged a rather social democratic economic policy until the beginning of the 1990s, was forced to define a new growth model. The new growth strategy was formulated in the Growth, Employment and Redistribution (GEAR) plan of 1996 and is described by most observers as an orthodox economic policy programme (e.g. Bhorat et al., 2002, Gelb, 2005, Seekings and Nattrass, 2005). The internal logic of GEAR is based on the economic assumption that domestic as well as foreign investments are the driving force for growth. Therefore, the government committed itself in the GEAR strategy to establish an investment friendly environment. At the same time this strategy envisaged a diversification of the economy (e.g. increasing the growth of non-mineral exports, strengthening of the private sector, etc.). To achieve this aim the GEAR plan defined four major fields of action: fiscal policy, trade policy, the labour market and privatisation. Whereas both fiscal austerity and trade liberalisation were implemented immediately, government policy with respect to the labour market and privatisation were not. As argued by Seekings and Nattrass (2005) labour market

reforms, as described above, were contrary to the aim of labour market flexibility envisaged in the GEAR program. The effect of this economic transition on the workplace will be discussed further in this chapter.

The social transition refers to social inclusion and exclusion. During apartheid race was the key factor to determine the distribution of power and the access to resources, occupations and skills. Since the segregation with respect to landownership and education is important to understand specific problems of the South African labour market, these topics will be discussed more thoroughly. The Group Areas Act (1950) and the Bantu Authorities Act (1951) limited the right to landownership and shaped the geographical distribution of labour in apartheid South Africa. Whereas the first act regulated racial segregation in cities and towns, the second act built the basis for the deportation of Africans to native reserves, so called homelands or bantustans. As a result there was not only a racial residential segmentation, but also a differentiation within the African labour force. A part of the African labour force with access to an urban job could reside in urban areas. The others were doomed to migrant labour, low-wage work in the agricultural sector or unemployment in rural areas. To make matters worse, development was non-existing in the homelands which became more and more characterised by high poverty rates and overpopulation. (Seekings and Nattrass, 2005, 18-22) Another field by which the apartheid government secured the advantageous position of white people in the society was education. Whereas in the 1950s mainly job reservations and colour bars were used to secure higher incomes for white labour, different educational systems made this praxis partly redundant during the following decades. The apartheid government pushed the education of all white citizens by investing in secondary education. At the beginning of the 1970s the younger generation of the white population was well educated. Keeping account with the fact that the level of education is positively correlated with earnings, it is clear that this advantage created racial income inequality. (Seekings and Nattrass, 2005, 133-136) In the post-colonial society this distribution is contested and redistribution occurs. (Von Holdt and Webster, 2005) In Chapter 10 of their book "Class, Race, and Inequality in South Africa" Seekings and Nattrass (2005, 340-375) partly analyse this redistribution. They conclude that the distributional regime of post-apartheid South Africa is based upon a double class compromise. Whereas the business community secured pro-business macroeconomic policies, working class secured higher wages and pro-poor social policies. The main policy focus was de-

racialisation and had two major components. On the one hand, the new government banned racial discrimination from public policy (e.g. education). On the other hand, it offered previously discriminated citizens new economic opportunities by means of affirmative action (e.g. Black Economic Empowerment). As argued by Seekings and Nattrass (2005) due to the social transition race was replaced by class as key factor with respect to social inclusion and exclusion.

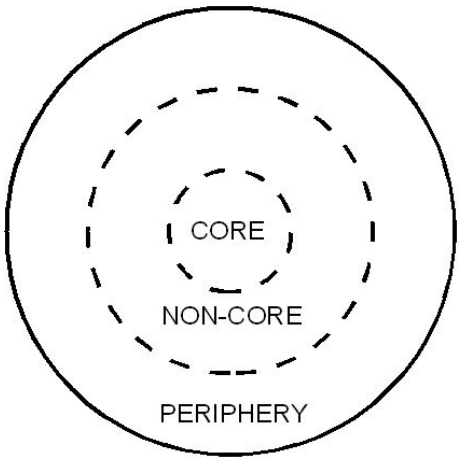

Figure 3.1: Three zones of the labour market

Since this triple transition strongly influenced different social domains, it is necessary to embed the workplace in its social context. The broad approach from Von Holdt and Webster (2005) does not only consider formal employment, but also informal and subsistence activities as well as unemployment. They distinguish intentionally between the concept of earning a living and making a living. Whereas the former refers to regular and paid employment the latter comprises people who generate their own income or create their own subsistence activities. (Von Holdt and Webster, 2005, 4) Furthermore, the authors argue that the observed restructuring of the labour market results in growing differentiation, which produces three zones (or worlds of work) visualised in Figure 3.1. These zones are asymmetric and interdependent. According to Von Holdt and Webster (2005) the economic active population of 20.3 million individuals is distributed in the following way:

- Core (6.6 million): Core workers have more or less stable employment relations in the formal sector. Theron (2005, 295) describes these core workers by means of a standard employment relationship. This relationship is characterised by full time employment on the premises of the employer, i.e. an employee has only one employer, who controls the workplace. Furthermore, this relationship is permanent or ongoing for an indeterminate period.

- Non-Core (3.1 million): Individuals with less stable employment relations than those in the core zone. Moreover, their labour situation can be described as either casualised or externalised. Casualisation describes the situation in which temporary and part-time terms make the employment relationship insecure and unstable. Due to externalisation the industrial employment relationship is devolved to a nominal employer and thus replaced by a commercial relationship.

- Periphery (10.6 million): People in this zone are either unemployed (8.4 million) or make a living through activities in the informal sector (2.2 million).

According to Von Holdt and Webster (2005) the restructuring of the labour market is caused by a reduced autonomy of South Africa companies. Since 1994 three general trends can be observed in the South African economy. First, some South African companies became part of a global corporate or production structure. Second, independent companies integrated themselves in the global markets. Third, companies, who could not reap the benefits of the global market due to the lack of capital or capacity, experienced increased competition on the domestic market. By means of this approach the labour market will be analysed.

3.3 Employment Trends (1993-2006)

Since the scope of this thesis is to discuss the link between trade and the South African labour market, this section discusses only employment trends in sectors which produce tradable goods. As data source the Quantec - RSA Standardised Industry database, which offers standardised employment data, is used. (Quantec, 2007b) These employment data are gathered from different sources such as the Survey of Total Employment and Earnings, and the October Household Surveys of Statistics South Africa, the Manpower Surveys of the Department of Labour and

the Standardised Employment Series of the Development Bank of South Africa. The industry classification used in the employment data is based on the South African Standard Industry Classification and is thus identical to the industry classification used to analyse trade data. Therefore, 35 industries that produce tradable goods can be identified.

Figure 3.2 offers a good general impression of what happened with the number of employees in these industries. Between 1993 and 1996 employment increased slightly from 5.13 million to 5.22 million employees. However, in the period 1996-2002 the number of employees decreased by 0.44 million. Since 2002 this number remained roughly stable at around 4.8 million. This trend was contrary to the overall employment trend in this period. Whereas in 1993 the South African economy employed 10.86 million people, until 2006 this number increased by 1.32 million to 12.18 million. Therefore, the share of the 35 industries in total employment decreased during this period from 47.22% to 39.35%. With respect to the structural division of employment between the industries some observations are worth mentioning. First of all, it is interesting to mention that close to 30% of employment was registered in the *agriculture, forestry and fishing* industry aggregate and this share remained constant over time. This also means that the number of employees in this industry decreased in the same period. Whereas this industry employed 1.49 million people in 1993, only 1.33 million were employed in 2006. Note that this observation does differ significantly from Altman (2003, 163), which mentions a job loss in commercial agriculture of 0.75 million jobs between 1994 and 1996. Besides the fact that labour data are constructed differently in Altman (2003), the author also distinguishes between commercial and subsistence agriculture and excludes the informal sector. These three differences do not only explain the observed discrepancy, but indicate a dynamic change in this segment of the labour market. Second, the share of the *other producers* industry group increased between 1993 and 2006 from 21.10% to 24.20%. This corresponds with an increase from 1.08 million to 1.16 million employees. Third, the share of the *gold and uranium ore mining* industry aggregate more than halved during the considered period. Therefore, it is not surprising that most employment opportunities disappeared in this sector. The number of employees decreased by a quarter of a million from 0.41 million in 1993 to 0.16 million in 2006, the biggest decrease observed in the data. With respect to the three zones, it is safe to state that the share of both core and non-core employment decreased.

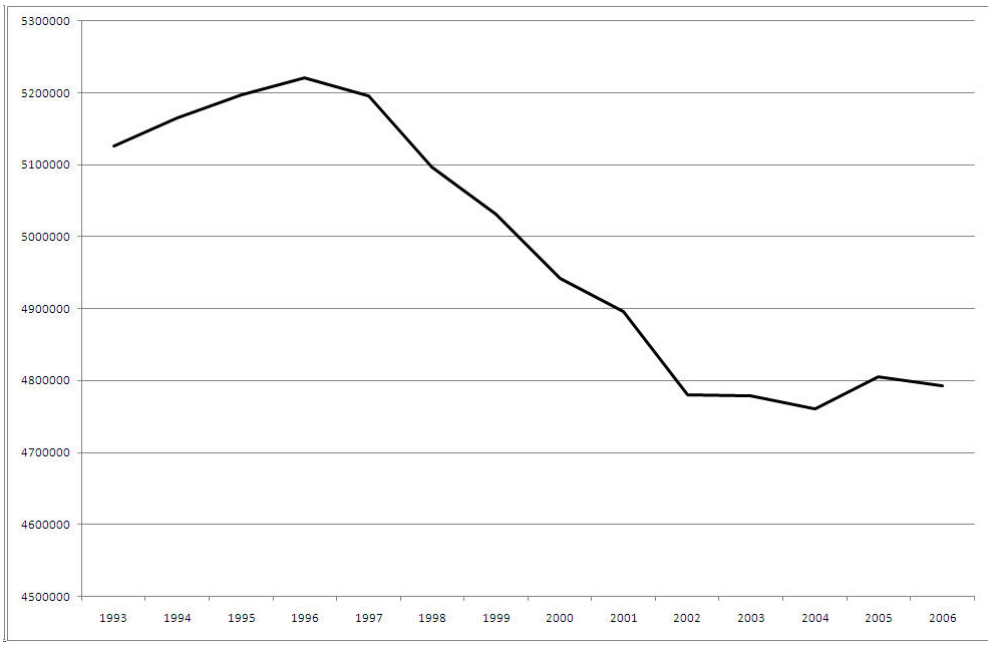

Figure 3.2: The evolution of employment in tradable sectors

Besides the industry aggregates the employment data feature four aggregated levels of employment types. On the one hand, the data distinguish between formal and informal employment. Although the data base does not offer a definition of informal employment, it uses most probably the same definition as the October Household Surveys of Statistics South Africa, since these surveys are indicated as one of the main sources. Statistics South Africa defines their informal employment indicator as: "This indicator identifies persons who are in precarious employment situations. It includes all persons in the informal sector and persons helping unpaid in their family business. It also includes employees in the formal sector and persons employed in private households who are NOT entitled to basic benefits from their employer such as a pension or medical aid and who also do not have a written contract of employment". (Statistics South Africa, 2008, 18) On the other hand formal employment is divided into three categories: highly skilled, skilled, and semi- and unskilled. Highly skilled occupations are defined as professional, semi-professional and technical occupations; managerial, executive and administrative occupations; certain transport occupations, e.g. pilot navigator. Skilled occupations are clerical occupations; sales occupations; transport, delivery and communications occupations; service occupations; farmer, farm

manager; artisan, apprentice and related occupations; production foreman, production supervisor. Semi- and unskilled occupations are defined as neither highly skilled nor skilled occupations. (Quantec, 2007b) This differentiation allows a closer look at the structural shift that happened between 1993 and 2006.

Whereas Figure 3.2 showed that 0.34 million employment opportunities disappeared, Figure 3.3 displays this change with respect to the four employment types. Remarkable is the fact that in all three formal employment categories the number of employees decreased and in sum 0.40 million formal jobs disappeared between 1993 and 2006. The number of highly skilled employees decreased by 0.04 million to 0.23 million. In 2006 only 0.91 million employees were classified as skilled, which means a reduction by 0.17 million with regard to 1993. A similar absolute loss (0.19 million) is observed amongst the semi- and unskilled class, but the number of employees in this class was with 2.72 million still the highest. Simultaneously the number of informal employees increased by 0.06 million to 0.94 million. This increase in informal employment conforms the findings of Von Holdt and Webster (2005) that since 1994 the South African working place was restructured and that the periphery and the non-core zone became crucial to understand the labour market.

Although it would go too far to discuss each industry aggregate separately, some general observations should be mentioned. As already mentioned above, the number of employees in the *agriculture, forestry and fishing* industry aggregate did fall significantly. This reduction is not only observable with respect to skilled (-0.09 million), and semi- and unskilled (-0.04 million) occupations, but also with regard to informal (-0.03 million) employment. Ewart and Toit (2005) describes how the dismantling of the regulatory regime, the influences of the world market and the distribution and sale of wine influenced employment in the wine industry. Whereas core workers, whose number decreased, faced new opportunities, the majority of the labour force were the main losers of these trends. A similar, but less strong, reduction occurred in the *non-metallic minerals* sector. In the *footwear*, the *wearing apparel* and the *textiles* industries the number of semi- and unskilled employees decreased, whereas the number of informal employees increased. In addition, the number of skilled employees decreased also in both the *footwear* aggregate and the *textiles* industry. These general result support the findings of two case studies with respect to the restructuring of the workplace

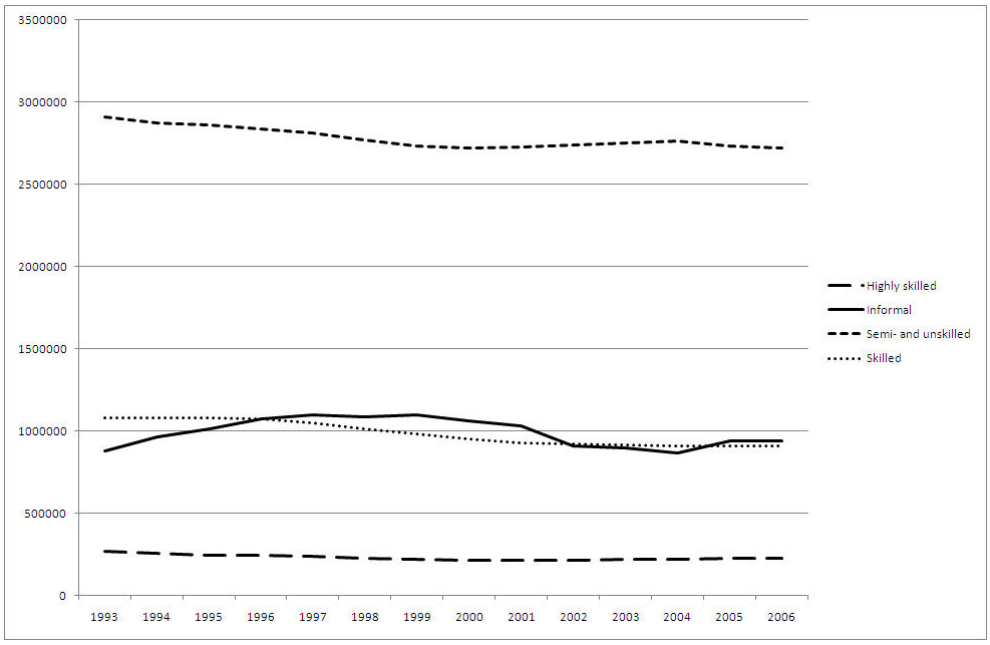

Figure 3.3: The skill structure of employment in tradable sectors

in the footwear industry at Pietermaritzburg (Mosoetsa, 2005) and in the Cape Town clothing industry (Westhuizen, 2005). The authors show that due to informalisation core workers experience increased insecurity and thus become non-core workers. In both industries informalisation describes the process of fragmentation through subcontracting. In the *gold and uranium ore mining*, the *food*, the *basic iron and steel* and the *electrical machinery and apparatus* industries formal employment figures decreased remarkably, but informal employment did change little, if it changed at all. The evolution within the *motor vehicles, parts and accessories* contrasts the previous observation, since in this sector the number of formal employment opportunities increased. The *other producers* and the *other manufacturing* industries experienced an increase in informal as well as semi- and unskilled employment. With an increase of 0.1 million semi- and unskilled employees the *other producers* industry registers the highest increase. Two other industries with a significant increase of informal employment are the *beverages* and the *wood and wood products* industries. Thus, whereas the general trend is a reduction of formal employment and an increase of informal employment, trends in some industries differ remarkably with this observation.

The above observations resemble those of other studies. Nattrass (2003, 141) states that "between 1990 and 2001, non-agricultural formal employment declined by over 20 per cent." Although an overall direct comparison is not suitable due to different time periods and a difference in the aggregated level of employment, Nattrass (2003, 142) also displays the decline in manufacturing employment and the drop in mining employment. Another study by Banerjee et al. (2008, 723) also supports these findings. Based upon the ratio of formal employment to GDP, which fell by 28 per cent in the period 1994-2001 to 4.9 employees per R1 million in output, Pollin et al. (2006, 10-11) concludes that in the formal economy employment stagnated. The following section offers possible explanations for these trends.

3.4 Explaining Stagnating Employment

In the face of these economic trends and the complexity of economic activity it would be inapt to focus only on one factor of explanation. Therefore, this section offers different viewpoints on cause for the decline of employment in tradable sectors.

As first factor the structural shift that happened in the South African economy should be mentioned. Whereas in 1993 sectors producing tradables still accounted for 38.20% of total economic output, this figure fell to 32.97% in 2006, as shown in Table 3.1. Note that Table 3.1 displays capital and GDP data as million rand at prices of the year 2000. This structural shift was also observed by Banerjee et al. (2008), which noted that this change cannot be regarded as a transitory shock. With regard to this shift both Nattrass (2003, 146) and Pollin et al. (2006, 10) emphasise the importance of the manufacturing and mining sectors. Pollin et al. (2006, 10) sees diminishing ore grades in combination with increased mechanisation as causes of decreased labour demand in the mining sector, whereas labour demand in the manufacturing sectors is linked to the process of globalisation. In order to increase productivity and thus remain globally competitive, firms invest in mechanisation. Another explanation is offered by Rodrik (2006). By means of a regression analysis the author concludes that the reduction of manufacturing output is caused by a decrease in its relative price to other sectors. This would make investments in manufacturing less attractive and also influences the demand for less-skilled labour. Furthermore, overall employment and unskilled employment in particular is significantly more sensitive to changes

in relative prices in manufacturing. Based on these observations it is save to say that the structural shift within the South African economy partly explains the decrease in labour demand.

Yearc	Capital (K)	Labour (L)	GDP-35 (Y)	GDP-Total (Yt)	L/K	Y/Yt (%)	Y/K
1993	582,116.10	5,126,597.70	273,495.60	715,976.00	8.81	38.20	0.4698
1994	583,577.40	5,165,791.80	280,090.10	734,878.50	8.85	38.11	0.4800
1995	589,987.60	5,196,528.20	282,898.00	752,297.30	8.81	37.60	0.4795
1996	598,859.20	5,220,519.50	291,685.90	781,016.50	8.72	37.35	0.4871
1997	607,152.10	5,195,542.50	297,896.10	799,872.70	8.56	37.24	0.4906
1998	611,351.60	5,096,547.70	296,443.30	804,998.40	8.34	36.83	0.4849
1999	611,553.90	5,031,576.90	297,513.60	826,130.50	8.23	36.01	0.4865
2000	611,206.00	4,942,625.30	311,675.80	862,845.10	8.09	36.12	0.5099
2001	612,582.70	4,896,653.80	316,704.80	887,948.00	7.99	35.67	0.5170
2002	614,810.00	4,780,528.70	326,100.40	921,992.70	7.77	35.37	0.5304
2003	618,760.30	4,778,254.20	326,585.00	950,665.50	7.72	34.35	0.5278
2004	623,528.00	4,760,716.80	337,902.00	995,707.90	7.64	33.94	0.5419
2005	629,556.30	4,805,909.80	351,189.20	1,043,545.40	7.63	33.65	0.5578
2006	640,518.70	4,792,080.60	363,301.50	1,101,796.10	7.48	32.97	0.5672

Table 3.1: Capital, labour and GDP data

A second factor, which is intertwined with the structural shift, is labour intensity. With respect to the overall labour to capital ratio in the 35 industries a steady decline can be observed. Using real capital data at prices of the year 2000 Table 3.1 shows that the ratio of 8.81 employees per one million rand in 1993 decreased to a ratio of 7.48 in 2006. Apart from six exceptions (the *furniture*, the *machinery and equipment*, the *metal products excluding machinery*, the *tobacco*, the *wearing apparel* and the *wood and wood products* industries) this decrease of labour intensity could be observed at industry levels. Whereas Banerjee et al. (2008, 722) as well as Pollin et al. (2006, 10) mention this trend, it is Nattrass (2003) that analyses this trend with respect to capital accumulation. By linking the rising trend of the capital to labour ratio to the decreasing output to capital ratio and to the historic increase of the capital stock for the period 1960-2001 and with regard to the manufacturing sectors Nattrass (2003, 146) concludes that "South Africa's rate of capital accumulation was over-rapid in manufacturing and that resources were wasted in the process." The results in Table 3.1, however, do not support this interpretation, since the output to capital ratio increases between 1993 and 2006. Nevertheless, the decrease in labour intensity of production affected labour demand negatively.

A third factor, which influences labour demand, is slow economic growth. Regarding the combined output of the 35 industry aggregates, as it is rep-

resented in Table 3.1, average annual output growth was 2.21% between 1993 and 2006. The average annual growth rate for the total economy for this period was 3.37%, similar to the average growth rate of 3.1% mentioned in Pollin et al. (2006, 9). In addition, output growth was volatile during the whole period. Whereas between 2003 and 2006 output grew annually by more than three per cent, the period 1997-1999 is characterised by a virtual standstill. Nattrass (2003) analyses a longer time period starting in 1960 until 2001 and frames the weak growth performance of the South African economy into a general growth strategy, which focussed on capital intensive industries. In this macroeconomic environment it is not surprising that labour demand falls by the wayside.

A fourth factor, which is often used to distinguish between different trends with respect to skilled and less-skilled labour is the shift in labour demand. As argued by Altman (2003, 164) there was a shift away from less-skilled labour in favour of skilled labour. Moreover, this shift was not only observed on the overall level, but in almost every sector. The data used in this thesis, however, do not confirm these findings. If only highly skilled labour is considered as skilled labour and the other three categories as less-skilled labour, then 21 out of 35 industries have a higher skilled to less-skilled labour ratio in 2006 in comparison to 1993. Moreover, the overall ratio of skilled to less-skilled labour decreases from 0.0546 in 1993 to 0.0500 in 2006. These results do not change substantially if informal labour is excluded from the analysis, as suggested by Altman (2003, 165): "Surprisingly, only 30 to 40 per cent are classified as 'elementary workers' and so the informal economy should not necessarily be seen as unskilled." A trend that can, however, be affirmed is the increase of the output to employment ratio. In 2006 this ratio increased by 20.72% with respect to 1993. Although, it should be noted that this increase was not observable in all industry aggregates. In ten industry aggregates the ratio did even decrease between 1993 and 2006. In conclusion, the supposed shift in demand to skilled labour cannot be confirmed, whereas the idea of increased labour productivity is supported.

Another factor, which is the topic of an intense academic debate, is the issue of labour costs. A distinction should, however, be made between wage levels on the one hand and the regulation of labour markets and the industrial relations system on the other hand. Based on different studies Bhorat et al. (2002) concludes that due to labour regulation the cost of doing business increased and that generating employment op-

portunities was hampered. A study of the Organisation for Economic Co-Operation and Development (OECD, 2008, 121-123) draws a different picture. Based upon the employment protection legislation (EPL) indicator, which maps the legal framework, the South African labour market appears relatively flexible. The OECD acknowledges, however, that this indicator does not capture believes and perceptions, which also influence the hiring policies of firms. With regard to the evolution of real wages Braude (2005, 405) notes an average annual increase of 2.5% between 1995 and 2002. Simultaneously, productivity increased on average by 4.8% per year. As a result, unit labour costs decreased. This observation is, however, contradicted by the unit labour costs time series of the South African Reserve Bank (2010). According to these data unit labour costs increased steadily during this period. Banerjee et al. (2008, 724) combines the October Household Survey with the September wave of the Labor Force Survey to describe the evolution of real wages. For the period 1995-2005 the authors estimate that real wages decreased around 10%, i.e. on a year-to-year basis real wages remained roughly stable. These data, however, do not correspond with the data provided by Statistics South Africa (2010b). Figure 3.4 displays the evolution of the remuneration of employees per employee adjusted by the Consumer Price Index (CPI) (Statistics South Africa, 2010a) or corrected by the GDP deflator (UNData, 2010). The calculation based upon the evolution of the CPI shows an average annual increase of 2.90% of real remuneration per employee between 1993 and 2006, whereas the data constructed with the GDP deflator displays an average annual increase of 1.36% in the same period. These findings are not only supported by Braude (2005, 405), but also by Seekings and Nattrass (2005, 352), which shows an increase of real remuneration between 2.5% and 3% on average per year between 1993 and 2002. Another study that finds evidence for this increase of real remuneration per employee is Rodrik (2006, 15). At the same time Rodrik (2006) decomposes this increase into two components: skill upgrading and a wage push. He estimates by means of a regression that the observed increase can be attributed to the structural change in skill composition of the labour force. The contribution of the skill-adjusted component to the increase of real remuneration was negligible. With respect to wage levels it should be mentioned that most studies (e.g. Braude, 2005, Banerjee et al., 2008) do find a union wage premium. Therefore it is save to say that labour unions fulfil a significant role in the South African labour market. Although it is clear that labour costs do influence labour demand, the academic discussion does not offer a clear

explanation for the evolution of these costs in the post-apartheid era.

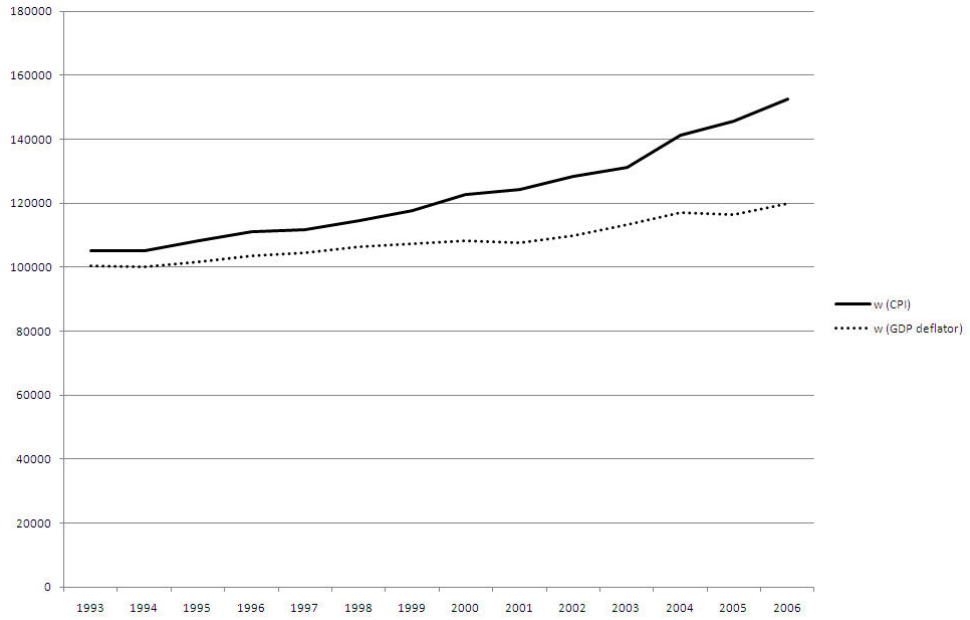

Figure 3.4: Real wages (based on the CPI and on the GDP deflator)

As will be shown later on, some of these explanations are endogenous to trade liberalisation in an Heckscher-Ohlin trade model. Before discussing the theoretic framework, however, the phenomenon of mass unemployment should also be explored.

3.5 Unemployment in South Africa

Most observers (e.g. Nattrass, 2003, Seekings and Nattrass, 2005, Banerjee et al., 2008) agree that unemployment is not a recent phenomenon in the South African society. Although an exact assertion cannot be made, scholars date the rise of widespread open, involuntary unemployment back to the 1970s. Seekings and Nattrass (2005, 185) offers the coercive apartheid policy of resettlement which forced previously underemployed persons to move to bantusans as possible explanation. Due to the lack of employment opportunities in subsistence agriculture or other economic activities in these regions, these persons became unemployed. Moreover, the fact that the South African economy slowed down during the 1970s and stagnated in the 1980s aggravated the unemployment problem. After

the transitions of the 1990s, persistent unemployment became a major concern of the new government.

During the apartheid era data collection on unemployment was unsystematic and flawed. Unemployment statistics of this period thus offer little insight. In the post-apartheid era Statistics South Africa started to collect population data systematically, but still some limitations remain. One major limitation is that the survey and sampling design was adapted several times. Whereas during the period 1994-1999 data were collected by means of the October Household Survey, since 2000 two waves of the Labor Force Survey are available. Table 3.2 displays participation, employment and unemployment rates calculated by Banerjee et al. (2008, 718). This calculation uses the October Household Surveys and the September wave of the Labor Force Survey and distinguishes between the International Labour Organization (ILO) classification and the broad definition. According to the ILO classification individuals are part of the labour force if they were employed or wanted to work during the week of reference. Moreover, they should be available to start working within a week and should have actively been looking for work during the past four weeks. By eliminating the requirement of active job search Banerjee et al. (2008) defines the broad definition. Although data limitations are at hand and data are thus not directly comparable, they can nevertheless be used to describe general broad trends since transition.

Year	ILO classification			Broad classification	
	Participation	Employment	Unemployment	Participation	Unemployment
1995	51.4	43.3	15.6	60.3	28.2
1997	48.2	37.5	22.1	60.6	38.0
1999	55.4	41.7	24.8	69.0	39.9
2001	59.4	47.4	30.3	72.1	42.5
2003	56.8	40.6	28.6	70.6	42.5
2005	57.2	41.9	26.7	71.2	41.1

Source: Banerjee et al. (2008)

Table 3.2: Participation, employment and unemployment Rates (%)

What can be observed from the data in Table 3.2 and what is also supported by the findings of Seekings and Nattrass (2005, 318) is that unemployment increased significantly in the post-apartheid era. Whereas in 1995 the narrow ILO unemployment rate of 15.6% was already high, it surged to 30.3% at the beginning of the new millennium and was at 26.7% in 2005. This trend can best be explained by an increase of labour sup-

ply visualised by rising participation rates and a decrease in employment rates. Measures based upon the broad definition display a similar trend. With respect to the participation rate Banerjee et al. (2006, 719) note in a previous publication that especially the participation of female citizens increased significantly. Furthermore, the South African statistics display some general characteristics such as higher unemployment rates for female, rural and less educated labour force participants. In addition, the racial component, which is highly relevant for South Africa, plays a major role. Whereas people defined as whites during apartheid exhibit a low incidence rate of unemployment, previously classified Africans have unemployment rates that are at least six times the rates of whites. (Banerjee et al., 2006, 13)

With regard to the broad definition one should first make sure that those individuals, who are not actively looking for a job, are part of the labour force. Banerjee et al. (2008, 718) recognise this problem, but do not elaborate on this topic. As noted, however, by Kingdon and Knight (2006, 294) the situation of jobless people, who use passive search methods can be interpreted twofold. The first hypothesis is called the *taste for unemployment* hypothesis and describes a situation in which jobless persons choose to be unemployed. Many jobless individuals are provided for by the household they belong to. This intra-household transfer could induce a disincentive to actively look for a job and this disincentive is positively correlated with the household income. A second hypothesis is known as the *discouraged worker* hypothesis. According to the discouraged worker hypothesis unemployed individuals are not looking actively for a job since they perceive the probability of finding work very low. This believe can be based on their own long-term unemployment or on high unemployment rates in society. These hypotheses have different implications for the labour force. Whereas in the case of the taste for unemployment hypothesis jobless, non-searching individuals should not be included to the labour force, discouraged jobless individuals are part of this labour force. Kingdon and Knight (2006, 309) conclude that the discouraged worker hypothesis describes best the situation in South Africa and that it makes sense to explicitly consider the broad definition of unemployment. Moreover, they show that wage setters take account of discouraged unemployed persons and that discouraged work seekers influence wage levels.

One of the main problems of being unemployed is its duration. Long-term unemployment is for many jobless persons social reality. Almost 60% of all individuals classified as unemployed (ILO definition) have never worked before. Moreover, close to 70% of this group are already more than one year on job-search. Of those who worked have before around 60% have been employed for more than a year. (Banerjee et al., 2008, 721) These figures indicate further that unemployment is a structural problem, although Banerjee et al. (2008) observe "a high level of mobility at the individual level." (Banerjee et al., 2008, 730) Moreover, considering the long duration of being unemployed it is relevant to take a closer look at this group of people. Seekings and Nattrass (2005) analysed the group of unemployed individuals and come to the conclusion that a significant segment of this group constitute an underclass, i.e. they face considerable disadvantages in the labour market. Although the authors remark that their results are tentative, they define six factors, which enforce this special disadvantage faced in the labour market. These factors are a lack of skill, a lack of social capital with respect to households, a lack of social capital with respect to friends and relatives, a lack of financial capital, geographical location and the duration of unemployment. Thus, being long-term unemployed easily leads to a vicious circle and makes it harder to secure employment in the future.

As already indicated, the decrease of the employment share and an increase of the participation rate both contribute to the observed unemployment rate. Whereas the reasons of decreasing employment opportunities are similar to those previously described with respect to the industries producing tradables, higher participation rates are more difficult to explain. As noted by Banerjee et al. (2008, 721) the increase in labour supply was mainly due to a considerable increase of participation of Africans, young people and females. Moreover, they estimate that this change account for 31% of the unemployment increase observed between 1995 and 2005. In the wake of transition more people entered the labour market which aggravated the unemployment problem. In the following section possible scenarios are presented that could explain unemployment within the Heckscher-Ohlin trade model.

3.6 Unemployment in a Trade Framework

Based on the insights gathered in the previous sections it is now possible to replace the market clearing condition with respect to the labour

market with more realistic assumptions. Although different alternatives are possible this discussion focusses on wage rigidity. This limitation is appropriate since it captures the core of the academic discussion with respect to unemployment in a trade framework. Through the adjustments of the trade model it is possible to analyse the effect of trade liberalisation on employment.

3.6.1 The rigid wage argument

The descriptive analysis of the labour market supports the argument that wages for unskilled labour in South Africa are more or less rigid. This thesis would like to emphasise three different channels, which influence the wage level for unskilled labour: labour legislation and minimum wages, reservation wages, and labour market frictions. In the following discussion each component and its effect on the wage level will be discussed.

In the wake of the political transition a new regulation of labour markets and the industrial relations system emerged. As noted by Bhorat et al. (2002), the general impression amongst business participants is that the chosen form of labour legislation increased the cost of doing business. Besides new rules with which employers have to comply, this regulation also introduced binding minimum wages. These minimum wages are a result of agreements reached within bargaining councils. Therefore, they vary not only from sector to sector, but also from job category to job category. (Braude, 2005, 440-444) The regulation of the labour market was part of the new growth path for South Africa which was developed by the new government. Nattrass (2001) describes this growth path as "High Productivity Now" and argues that the aim of the new government is to overcome the legacy of apartheid. With respect to the labour market this legacy consisted of low wages for the non-white labour force, which was also markedly less educated. By means of promoting highly productive industries government officials aspired to create a (fast) growing economic environment which could support higher wages for less-skilled workers. As a result of this regulation one can assume that the wage for less-skilled labour has increased.

Whereas the previous paragraph discussed the demand side of the labour market, it is also possible to interpret rigid wages from the supply side. In this case the reservation wage of workers is higher than the market clearing wage. This topic is discussed by Banerjee et al. (2008). In their

paper the authors argue that employment and labour market participation on household levels is influenced by the social pension program. Part of the social transition was the extension of the generous old-age pension that was in place for whites to the rest of the population and which offers a compensation around twice the per capita income. Workers in households receiving such a pension can thus be supported by old members of this household. (Banerjee et al., 2008, 735) A general effect on the labour market is that firms have to offer higher wages to find employees. The impact of this reservation wage argument is also an increase of the wage for less-skilled labour.

A third factor that could explain rigid wages within the South African context refers to labour market frictions. Whereas the other two arguments consider the supply and the demand side of labour markets, the functioning of these markets are now taken into account. The main frictions are the geographical segmentation and the skills of workers. The segmentation policy of the apartheid government did not only create reserves of less-skilled labour in the bantustans, but did also create industrial agglomerations (e.g. Gauteng, Cape Town, Durban, etc.). Therefore, job searchers are less informed concerning the availability of jobs and their characteristics. Moreover, when searching for a job they face a rather basic public transport system, which aggravates the problem. (Banerjee et al., 2008, 734) Another problem is the inheritance of the segmented educational system. Whereas older generations only have a few years of schooling, younger generations benefited from the transformation of the educational system and have around ten years of schooling. Older generations are thus partly handicapped. Due to the new schooling system the benefits of education have probably fallen. Moreover, employers face difficulties to assess the skills of potential employees. (Banerjee et al., 2008, 736) These frictions result in extra costs in the search and matching procedure on the labour market and thus augment the wage for less-skilled labour. (Cahuc and Zylberberg, 2004, 518-523)

As already has been indicated, each of these arguments discusses a different aspect of labour markets. The effect on the wage level of less-skilled labour is, however, similar. In order to discuss this effect without making things unnecessarily complicated wage rigidity will be regarded as a binding minimum wage. The following subsection gives an overview of literature which deals with the effect of a minimum wage within a trade model. Afterwards, the generated insights of this overview will be

applied to the trade model which was developed in the previous chapter.

3.6.2 The theoretical discussion

In the literature on international trade the problem of unemployment got some attention. The discussion in this subsection will, however, focus on the impact on employment of a binding minimum wage within the Heckscher-Ohlin trade theory. One of the first papers dealing with this problem was Brecher (1974). The starting point of his analysis is a standard two-dimensional Heckscher-Ohlin trade model in which an exogenously specified wage level in real terms is introduced. Subsequently the impact of this minimum wage on the shape of the transformation curve is discussed. Brecher (1974) distinguishes three different areas on this transformation curve. The first situation is characterised by incomplete specialisation and the fact that the minimum wage is not binding. As a result both production factors are fully employed. In the second situation incomplete specialisation still occurs, but the minimum wage is binding. In this case he shows that labour will be partly unemployed. In the last situation the minimum wage remains binding, but complete specialisation into the non-labour intensive good occurs. In this situation labour can also be partly unemployed, although under some extreme circumstances it will be full employed. In a next step Brecher (1974) discusses the supply and demand side of the products. Based on these insights an assessment of free trade is made and alternative trade policies are discussed. The basics of Brecher (1974) were also used by other scholars.

Another paper that uses a similar trade model is Krugman (1995). Whereas the first part of the paper starts with a detailed descriptive analysis of growing world trade and offers some general explanations for this phenomenon, it also discusses the impact of increased manufacturing exports from newly industrialised economies (NIEs) on the labour markets in Europe and in the USA. More specificly, Krugman (1995) tries to explain by means of a two-dimensional Heckscher-Ohlin trade model the increase of the wage gap in the USA and the increase of unemployment in the European Union as a result of export growth in low-wage countries. Whereas the discussion with respect to the labour market of the USA is irrelevant for this thesis, the impact of low-wage imports on the European labour market is, however, highly interesting. Contrary to Brecher (1974), which defines the labour market distortion as a binding minimum real wage, Krugman (1995) assumes that the relative wage of skilled to

less-skilled labour is fix. Due to this assumption trade between the EU and the NIEs does not influence relative prices. Therefore, as long as the EU produces both commodities, trade with the low-wage NIEs causes unemployment of European less-skilled labour. Within this framework Krugman (1995) distinguishes between a direct and an indirect effect of trade. Due to competition with imports from the NIEs employment opportunities disappear - this is the direct effect. Simultaneously, overall European income decreases since unemployed labour does not earn any income. The indirect effect of this is that domestic demand decreases, which will also cause unemployment. Krugman (1995) shows not only that within the trade model unemployment increases due to trade, but it also discusses different channels that explain this phenomenon.

Davis (1998) took the analysis of Krugman (1995) one step further. As previously shown Krugman (1995) discusses on the one hand the effect of trade between the USA and the NIEs on the American wage levels. On the other hand the effect of trade between the EU and the NIEs on unemployment levels in Europe is examined. Davis (1998) criticises the fact that these analyses are treated separately and offers a framework which also considers trade between the flexible-wage USA and the minimum-wage EU. Similar to Brecher (1974) the minimum wage for less-skilled labour is defined in real terms and not as fixed relative wages. The results remain, however, the same. Trade with the low-wage NIEs increases unemployment in the European labour market. Simultaneously trade between the EU and the USA also induces an unemployment effect in Europe. Davis (1998, 483) puts it as follows: "In effect, trade has forced European workers to bear the burden of high unemployment to maintain not only their own high wages, but that in America as well." The insights of these papers will now be used to fine tune the three-dimensional trade model constructed in the previous chapter.

3.6.3 Adjusting the endowment triangle

As indicated in the previous chapter the theoretic model should be adjusted to include employment effects of trade liberalisation. The first adjustment made, concerns the educated guess with respect to factor endowments. Since neither China nor the EU face a dramatic unemployment problem of less-skilled labour, endowment figures of these regions are not corrected. In South Africa, however, the assumption can be made that around 40% of the labour force is unemployed. Moreover, unemployed individuals are characterised by a low level of formal education.

Therefore, the educated guess for South Africa is adjusted. Whereas in the previous chapter only 9.6 million workers were considered as less-skilled, this figure is adjusted to 17.8 million. Table 3.3 displays the implications of this adjustment. Whereas the relative share of both the EU and China changes little, this share for South Africa increases from 1.27% to 2.33%. this adjustment will also influence the position of the endowment points of the countries with regard to the world endowment in the endowment triangle.

	Skilled Labour	Less-Skilled Labour	Capital
South Africa	2642000	17824667	N.A.
China	49298980	619007180	N.A.
EU	78805515	129246125	N.A.
World	130746495	766077972	N.A.
Normalised	Skilled Labour	Less-Skilled Labour	Capital
South Africa	2.02%	2.33%	5.00%
China	37.71%	80.80%	40.00%
EU	60.27%	16.87%	55.00%
World	100.00%	100.00%	100.00%

Table 3.3: Adjusted educated guess concerning endowments

Figure 3.5 displays the new positions of the three countries within the endowment triangle. Since the relative ratios for the EU and China with regard to the world economy do not change much, only the new endowment points of these countries are plotted. The position of South Africa does change substantially and therefore both points are plotted. Within Figure 3.5 point SA refers to the South African economy including unemployed labour, whereas point $SA - u$ neglects this mass of less-skilled labour. Notwithstanding this shift the only relative change with regard to the world endowment is that the less-skilled to skilled labour ratio of South Africa is higher than this ratio for the world economy. In the following subsection the implications of a binding minimum wage on the South African labour market are discussed. As a consequence the difference between the point SA and $SA - u$, which indicates unemployed less-skilled labour, can be analysed.

3.6.4 The theoretical model

To introduce a binding minimum wage only a minor adjustment of the theoretical model is needed. Since the aim is to discuss unemployment

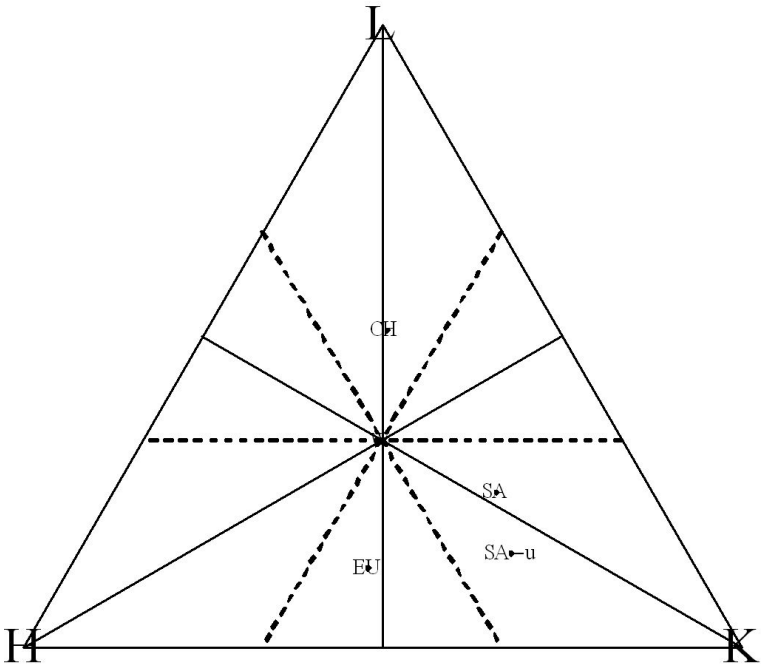

Figure 3.5: The adjusted endowment triangle

of less-skilled labour it is logical that the market clearing condition with respect to this production factor is discarded. Simultaneously, a binding minimum wage for less-skilled labour, $\bar{w}_L$, replaces the remuneration of less-skilled labour as expressed by Equation 2.4. Due to this change Equation 2.1 should be rewritten as follows:

$$\sum_j a_{Lj} x_j \leq v_L \tag{3.1}$$

Thus Equation 3.1 allows that only a part of the available less-skilled labour resources are used. Consequently the part that is not used in the production process will be unemployed. In the next step these adjustments are analysed in the Cobb-Douglas setting as displayed in Section 2.8.

One of the first differences is the fact that input vectors with respect to less-skilled labour cannot be expressed anymore as a function of total less-skilled labour endowment. Whereas Equation 2.50 is still valid for both skilled labour and capital, input vectors for less-skilled labour are, due to the binding minimum wage, now defined as a function of this

minimum wage and total factor endowment with regard to skilled labour and capital. This results in following expressions for the input vectors:

$$v_{ij} = \frac{v_i \delta_j \rho_{ij}}{\sum_j (\delta_j \rho_{ij})} \quad \text{for} \quad i = H, K \tag{3.2}$$

$$v_{Lj} = \delta_j \frac{\rho_{Lj}}{\rho_{L1}} \left(\frac{B_1 \rho_{L1}}{\bar{w}_L} \right)^{\frac{1}{1-\rho_{L1}}} \left(\frac{v_H \rho_{H1}}{\sum_j (\delta_j \rho_{Hj})} \right)^{\frac{\rho_{H1}}{1-\rho_{L1}}} \left(\frac{v_K \rho_{K1}}{\sum_j (\delta_j \rho_{Kj})} \right)^{\frac{\rho_{K1}}{1-\rho_{L1}}} \quad \text{with} \quad j = 1, 2, 3 \tag{3.3}$$

Whereas the input vectors with respect to capital and skilled labour are the same as those from Section 2.8, the input of less-skilled labour is changed. To be more precise, as long as the minimum wage is binding, i.e. is higher than the market clearing wage defined in Section 2.8, the amount of less-skilled labour used in the three industries is reduced. It is straightforward to prove this statement, since the first order derivative of Equation 3.3 with respect to the minimum wage is negative. An increase of the minimum wage thus implies a reduction of less-skilled labour used in the production process of all industries, which results in unemployment of less-skilled labour.

It is also possible with this information to analyse the impact of trade liberalisation on the input vectors. Once again the index W is used for variables of the general equilibrium on world level, whereas the index SA indicates variables of the autarkic South African economy. Since the input with respect to both skilled labour (H) and capital (K) are the same as those in Section 2.8 it is straightforward to show that capital intensity decreases relative to skilled labour due to trade liberalisation. The other changes are derived by combining the equations for input vectors and the information of Figure 3.5 the following way:

$$\frac{v_{Kj}}{v_{Lj}} = \frac{\frac{v_K \delta_j \rho_{Kj}}{\sum_j (\delta_j \rho_{ij})}}{\delta_j \frac{\rho_{Lj}}{\rho_{L1}} \left(\frac{B_1 \rho_{L1}}{\bar{w}_L} \right)^{\frac{1}{1-\rho_{L1}}} \left(\frac{v_H \rho_{H1}}{\sum_j \left(\delta_j \rho_{Hj}\right)} \right)^{\frac{\rho_{H1}}{1-\rho_{L1}}} \left(\frac{v_K \rho_{K1}}{\sum_j \left(\delta_j \rho_{Kj}\right)} \right)^{\frac{\rho_{K1}}{1-\rho_{L1}}}}$$

$$\Rightarrow \frac{\frac{v_{Kj}^{SA}}{v_{Lj}^{SA}}}{\frac{v_{Kj}^{W}}{v_{Lj}^{W}}} = \frac{\left(\frac{v_K^{SA}}{v_H^{SA}} \right)^{\frac{\rho_{H1}}{1-\rho_{L1}}}}{\left(\frac{v_K^{W}}{v_H^{W}} \right)^{\frac{\rho_{H1}}{1-\rho_{L1}}}}$$

$$\Rightarrow \frac{v_{Kj}^{SA}}{v_{Lj}^{SA}} > \frac{v_{Kj}^{W}}{v_{Lj}^{W}} \tag{3.4}$$

$$\frac{v_{Hj}}{v_{Lj}} = \frac{\frac{v_H \delta_j \rho_{Hj}}{\sum_j (\delta_j \rho_{ij})}}{\delta_j \frac{\rho_{Lj}}{\rho_{L1}} \left(\frac{B_1 \rho_{L1}}{\bar{w}_L}\right)^{\frac{1}{1-\rho_{L1}}} \left(\frac{v_H \rho_{H1}}{\sum_j \left(\delta_j \rho_{Hj}\right)}\right)^{\frac{\rho_{H1}}{1-\rho_{L1}}} \left(\frac{v_K \rho_{K1}}{\sum_j \left(\delta_j \rho_{Kj}\right)}\right)^{\frac{\rho_{K1}}{1-\rho_{L1}}}}$$

$$\Rightarrow \frac{\frac{v_{Hj}^{SA}}{v_{Lj}^{SA}}}{\frac{v_{Hj}^{W}}{v_{Lj}^{W}}} = \frac{\left(\frac{v_H^{SA}}{v_K^{SA}}\right)^{\frac{\rho_{K1}}{1-\rho_{L1}}}}{\left(\frac{v_H^{W}}{v_K^{W}}\right)^{\frac{\rho_{K1}}{1-\rho_{L1}}}}$$

$$\Rightarrow \frac{v_{Hj}^{SA}}{v_{Lj}^{SA}} < \frac{v_{Hj}^{W}}{v_{Lj}^{W}} \tag{3.5}$$

Note that these inequalities are only a consequence of the relative endowment of South Africa with capital and skilled labour. The endowment with less-skilled labour is not relevant, since a binding minimum wage is introduced and less-skilled labour will be partly unemployed. With respect to the input of capital relative to less-skilled labour Inequality 3.4 shows that trade liberalisation induces a less intensive use of capital. This result as similar as the result obtained in Section 2.8. What is more interesting is the fact that in a trade model with a rigid labour market production in all industries becomes more skilled labour intensive with respect to less-skilled labour. This result, displayed by Inequality 3.5, is the opposite of what was derived in Section 2.8. It is also interesting to notice that the ratio $v_{Kj}^{W}/(v_{Lj}^{W}$ is smaller in a system with a binding minimum wage than in a system for which the market clearing condition holds. This can easily be shown by comparing Equation 2.50 with Equation 3.3. Thus the wage rigidity for less-skilled labour weakens the adjustment effect.

By inserting the input vectors into the production functions the effect of the minimum wage on production output can be analysed. The result is similar to Equation 3.3. Moreover, it also displays a negative relationship between output levels and the minimum wage.

$$x_j = \delta_j B_j \left(\frac{B_1 \rho_{L1}}{\bar{w}_L}\right)^{\frac{\rho_{Lj}}{1-\rho_{L1}}} \left(\frac{\rho_{Lj}}{\rho_{L1}}\right)^{\rho_{Lj}} \left(\frac{\rho_{Hj}}{\rho_{H1}}\right)^{\rho_{Hj}} \left(\frac{\rho_{Kj}}{\rho_{K1}}\right)^{\rho_{Kj}} \cdot \cdot \left(\frac{v_H \rho_{H1}}{\sum_j (\delta_j \rho_{Hj})}\right)^{\rho_{Hj} + \frac{\rho_{H1}\rho_{Lj}}{1-\rho_{L1}}} \left(\frac{v_K \rho_{K1}}{\sum_j (\delta_j \rho_{Kj})}\right)^{\rho_{Kj} + \frac{\rho_{K1}\rho_{Lj}}{1-\rho_{L1}}} \quad \text{with} \quad j = 1,2,3 \tag{3.6}$$

In the next step the relationship between the factor remuneration of capital as well as skilled labour and the binding minimum wage for less-skilled labour is discussed. Once again it can be shown that there exists a negative correlation between the binding minimum wage and the remuneration of the two other factors. Moreover, the relative remuneration of skilled labour with regard to capital is dependent on the factor endowment of these two factors. Following expressions display these relationships:

$$w_H = B_1^{\frac{1}{1-\rho_{L1}}} \rho_{H1}^{\frac{\rho_{H1}}{1-\rho_{L1}}} \rho_{K1}^{\frac{\rho_{K1}}{1-\rho_{L1}}} \frac{\rho_{L1}}{\bar{w}_L}^{\frac{\rho_{L1}}{1-\rho_{L1}}} \left(\frac{v_K}{v_H} \frac{\sum_j (\delta_j \rho_{Hj})}{\sum_j (\delta_j \rho_{Kj})}\right)^{\frac{\rho_{K1}}{1-\rho_{L1}}} \tag{3.7}$$

$$w_K = B_1^{\frac{1}{1-\rho_{L1}}} \rho_{H1}^{\frac{\rho_{H1}}{1-\rho_{L1}}} \rho_{K1}^{\frac{\rho_{K1}}{1-\rho_{L1}}} \frac{\rho_{L1}}{\bar{w}_L}^{\frac{\rho_{L1}}{1-\rho_{L1}}} \left(\frac{v_H}{v_K} \frac{\sum_j (\delta_j \rho_{Kj})}{\sum_j (\delta_j \rho_{Hj})}\right)^{\frac{\rho_{H1}}{1-\rho_{L1}}} \tag{3.8}$$

$$\frac{w_H}{w_K} = \frac{v_K}{v_H} \frac{\sum_j (\delta_j \rho_{Hj})}{\sum_j (\delta_j \rho_{Kj})} \quad \text{with} \quad j = 1,2,3 \tag{3.9}$$

The influence of the minimum wage on relative prices is not that clear-cut. Since prices are defined as relative prices with respect to a *numéraire* following equation can be deducted:

$$\frac{p_j}{p_1} = \left(\frac{1}{\bar{w}_L}\right)^{\frac{\rho_{L1}-\rho_{Lj}}{1-\rho_{L1}}} \frac{\left(B_1 \rho_{L1}{}^{\rho_{L1}} \rho_{H1}{}^{\rho_{H1}} \rho_{K1}{}^{\rho_{K1}}\right)^{\frac{1-\rho_{Lj}}{1-\rho_{L1}}}}{B_j \rho_{Lj}{}^{\rho_{Lj}} \rho_{Hj}{}^{\rho_{Hj}} \rho_{Kj}{}^{\rho_{Kj}}} \cdot \cdot \left(\frac{v_H}{\sum_j (\delta_j \rho_{Hj})}\right)^{\frac{\rho_{H1}\left(1-\rho_{Lj}\right)}{1-\rho_{L1}} - \rho_{Hj}} \cdot \cdot \left(\frac{v_K}{\sum_j (\delta_j \rho_{Kj})}\right)^{\frac{\rho_{K1}\left(1-\rho_{Lj}\right)}{1-\rho_{L1}} - \rho_{Kj}} \quad \text{with} \quad j = 1,2,3 \tag{3.10}$$

The sign of the first order derivative is defined by the sign of $\rho_{Lj} - \rho_{L1}$. Since the production of industry 3 is less-skilled labour intensive, the relative price of commodity 3 is thus positively correlated with the binding minimum wage for less-skilled labour. This result is also intuitively logic, given the dynamics of the model. The influence of the minimum wage on the relative price of commodity 2 cannot, however, be defined by means of the made assumptions concerning production technology. The next subsection focusses on unemployment within the model and assesses changes caused by trade liberalisation.

3.6.5 The impact of trade on unemployment

Whereas in the previous subsection a binding minimum wage was introduced and its influence on different parameters are discussed, this subsection will exclusively treat unemployment. First the rate of unemployment will be defined for the autarkic South African economy. Subsequently the change of unemployment in an international context will be analysed. As a result the correlation between unemployment and the binding minimum wage can be established.

First, the relationship between the wage for less-skilled labour and factor endowments is established. This is done by using Equation 2.4 with respect to industry 1 and the production factor less-skilled labour. In this equation the input vectors are substituted by Equation 2.50. This approach yields following expression for the remuneration of less-skilled labour:

$$\frac{w_L}{p_1} = \frac{\rho_{L1}}{v_L 1} B_j v_{L1}^{\rho_{L1}} v_{H1}^{\rho_{H1}} v_{K1}^{\rho_{K1}} \tag{3.11}$$

$$\begin{aligned} \frac{w_L}{p_1} &= B_j \rho_{L1} \left(\frac{\delta_1 \rho_{L1} + \delta_2 \rho_{L2} + \delta_3 \rho_{L3}}{\delta_1 \rho_{H1} + \delta_2 \rho_{H2} + \delta_3 \rho_{H3}} \right)^{\rho_{H1}} \cdot \\ &\quad \cdot \left(\frac{\delta_1 \rho_{L1} + \delta_2 \rho_{L2} + \delta_3 \rho_{L3}}{\delta_1 \rho_{K1} + \delta_2 \rho_{K2} + \delta_3 \rho_{K3}} \right)^{\rho_{K1}} \cdot \left(\frac{v_H \rho_{H1}}{v_L \rho_{L1}} \right)^{\rho_{H1}} \cdot \left(\frac{v_K \rho_{K1}}{v_L \rho_{L1}} \right)^{\rho_{K1}} \end{aligned} \tag{3.12}$$

This market clearing wage can now be compared with the minimum wage, $\bar{w}_L$. The minimum wage is binding, if $\bar{w}_L > w_L$. According to Equation 3.12 a higher wage for less-skilled labour could be achieved by increasing either the amount of skilled labour or capital. This is, however, not possible since the endowments are assumed to be fix and cannot easily be increased. Another possibility would be to decrease the amount of

less-skilled labour used in the economy. This is possible and explains the rise of unemployment even in an autarkic South African economy.

Second, the impact of trade liberalisation can be analysed by comparing the general equilibrium of the world economy with the equilibrium of an autarkic South Africa. The amount of less-skilled labour not used in production is defined as U. Equation 3.12 can now be rewritten to yield an expression for the binding minimum wage in the following way:

$$\begin{aligned}\frac{\bar{w}_L}{p_1} &= B_j \rho_{L1} \left(\frac{\delta_1 \rho_{L1} + \delta_2 \rho_{L2} + \delta_3 \rho_{L3}}{\delta_1 \rho_{H1} + \delta_2 \rho_{H2} + \delta_3 \rho_{H3}} \right)^{\rho_{H1}} \cdot \\ &\quad \cdot \left(\frac{\delta_1 \rho_{L1} + \delta_2 \rho_{L2} + \delta_3 \rho_{L3}}{\delta_1 \rho_{K1} + \delta_2 \rho_{K2} + \delta_3 \rho_{K3}} \right)^{\rho_{K1}} \cdot \\ &\quad \cdot \left(\frac{v_H \rho_{H1}}{(v_L - U)\, \rho_{L1}} \right)^{\rho_{H1}} \cdot \left(\frac{v_K \rho_{K1}}{(v_L - U)\, \rho_{L1}} \right)^{\rho_{K1}} \end{aligned} \tag{3.13}$$

Under the assumption that the binding minimum wage in South Africa also influences the general equilibrium on a global level following equations can be deducted:

$$\begin{aligned}&\left(\frac{v_H^{SA} \rho_{H1}}{(v_L^{SA} - U^{SA})\, \rho_{L1}} \right)^{\rho_{H1}} \left(\frac{v_K^{SA} \rho_{K1}}{(v_L^{SA} - U^{SA})\, \rho_{L1}} \right)^{\rho_{K1}} = \\ &\qquad \left(\frac{v_H^{W} \rho_{H1}}{(v_L^{W} - U^{W})\, \rho_{L1}} \right)^{\rho_{H1}} \left(\frac{v_K^{W} \rho_{K1}}{(v_L^{W} - U^{W})\, \rho_{L1}} \right)^{\rho_{K1}} \end{aligned} \tag{3.14}$$

$$\left(\frac{\left(v_L^W - U^W\right) \rho_{L1}}{(v_L^{SA} - U^{SA})\, \rho_{L1}} \right)^{\rho_{H1} + \rho_{K1}} = \left(\frac{v_H^W}{v_H^{SA}} \right)^{\rho_{H1}} \left(\frac{v_K^W}{v_K^{SA}} \right)^{\rho_{K1}} \tag{3.15}$$

Since the world endowment is defined as the sum of the endowments of South Africa, the EU and China, it is clear to see that the left hand side of Equation 3.15 is positive and bigger than one. Moreover, by using this information the right hand side of Equation 3.15 can be rewritten as:

$$\frac{v_L^W - U^W}{v_L^{SA} - U^{SA}} > 1$$

$$\Rightarrow v_L^W - U^W > v_L^{SA} - U^{SA}$$

$$\Rightarrow v_L^W - v_L^{SA} > U^W - U^{SA}$$

$$\Rightarrow \frac{v_L^W - v_L^{SA}}{U^W - U^{SA}} > 1 \tag{3.16}$$

The fraction given in Inequality 3.16 shows that unemployment of less-skilled labour will increase in the wake of trade liberalisation. The numerator of this fraction is positive and this implies that the difference between U^W and U^{SA} is also positive. Under the assumption that unemployment of less-skilled labour only occurs in South Africa this implies that trade liberalisation increases the amount of unemployed less-skilled labourers in South Africa.

3.7 Conclusion

It should be clear by now that the transition that took place in South Africa in 1994 influenced different aspects of society. The political transition is not only characterised by the empowerment of the majority of citizens, but also by an attempt of building a new, non-adversarial industrial relations climate. The economic transition was provoked by the insolvency of the apartheid industry policy. The new government introduced a new growth strategy which was marked by the GEAR plan. The social transition opened up new opportunities for the formerly discriminated non-white population. However, these transitions could not change structural disadvantages over night.

These transitions influenced, however, labour markets and induced a restructuring. As discussed, three intertwined zones could be distinguished: core, non-core and periphery. Based on the available labour market data on sectors that produce tradable commodities it was shown that the overall trend was a worsening of labour conditions and of employment opportunities. Especially in different mining industries employment fell between 1993 and 2006. Moreover, most jobs which disappeared required little or no skills. This has severe consequences for the formerly discriminated non-white labour force which still faces structural disadvantages.

Various possible explanations have been offered by different scholars. With respect to the trade model these can be divided into two different causes. On the one hand the structural shift away from the primary and secondary sectors to the tertiary sector, slow economic growth as well as the increased cost of labour can be regarded as exogenous evolutions. On the other hand the decreased labour intensity of production as well

as the substitution of less-skilled labour by skilled labour could be endogenous effects caused by trade. Notwithstanding these considerations it is save to state that the increase of unemployment between 1994 and 2006 can partly also be contributed to these evolutions.

Based on the descriptive analysis some main arguments are formulated that support the assumption that the South African labour market faces some rigidities. Although these rigidities concern different aspects of this market, they are pooled together as a binding minimum wage. This approach simplifies the discussion of unemployment in the theoretical framework. Within the trade model the market clearing condition for less-skilled labour is substituted by the definition of this wage. As a result the implications of the minimum wage for production output, commodity and factor prices as well as input vectors can be analysed. Whereas production becomes less capital intensive with respect to both types of labour due to trade liberalisation, the analysis predicts an increase of the skilled to less-skilled labour ratio. The last result is the opposite result of the analysis within the trade model without unemployment. The main finding is that within this theoretical framework the binding minimum wage causes unemployment of less-skilled labour and that in combination with trade liberalisation unemployment increases.

To conclude this chapter it should be noted that with respect to the theoretical model three different scenarios for South Africa are possible: no specialisation, partial specialisation and complete specialisation. This chapter treats, however, only the case of no specialisation, i.e. the South African economy keeps on producing the three commodities. In the case of partial specialisation the South African economy would produce only goods of industry 2 and 3. The scenario of complete specialisation would describe a South African economy only producing goods of industry 2. Whereas in the no specialisation and the partial specialisation scenarios only less-skilled labour will be partly unemployed, the complete specialisation scenario implies also that a part of capital will be unemployed. The discussion of these two possible scenarios are, however, beyond the scope of this thesis.

Chapter 4

Testing The Model

4.1 Introduction

Until now the link between trade and (un)employment is only discussed and analysed on a theoretical level. The general conclusion of this exercise was twofold. First, trade liberalisation induces a change of the factor intensities at industry levels. Capital is used less intensive. With respect to less-skilled labour this reduction is weaker in a system with wage rigidities than in a trading system with factor full employment. Moreover, in an economy with labour market rigidities the ratio of skilled to less-skilled labour increases. Without labour market rigidities this ratio would decline. Second, it was shown that due to labour market rigidities trade induces an increase of unemployment of less-skilled labour. To conclude this thesis it seems more than appropriate to analyse this relationship on an empirical level. This is the subject of this chapter.

This thesis is not the first study that takes a closer look on employment effects of trade liberalisation in South Africa. Therefore, this chapter starts with a literature overview. The summaries of other studies show that different approaches can be used for the empirical analysis (e.g. descriptive approach, factor content approach, input-output approach, etc.) However, none of these studies uses a consistent trade framework to analyse employment effects of trade. Moreover, the empirical papers on labour demand distinguish only between two production factors, whereas this thesis argues that it is important to distinguish three different types of production factors. Therefore, this chapter will examine two different estimation approaches. On the one hand, two estimation equations are defined with respect to factor intensities. This approach matches the

theoretical model which is developed in previous chapters. On the other hand, a less-skilled labour demand function is specified by means of a general production function with three production factors.

After the discussion of the econometric model the available data are described. This section is more or less a summary of the different data sources which have been already used in previous chapters. The interesting part of this chapter is, indeed, the estimation results. This chapter ends with a general conclusion that highlights its main findings.

4.2 Available Studies

This thesis is definitely not the first study that assesses the effect of trade on employment in South Africa. One of the first relevant studies treating this research question is Bell and Cattaneo (1997). In this report the authors use a descriptive approach for the period from 1985 to 1993. Although this period does not correspond with the period which is considered in this thesis, some general conclusions are worth mentioning. First, Bell and Cattaneo (1997) show that the production of exports was less labour intensive than the overall labour intensity of South African manufacturing sector. In addition, the labour intensity of exports decreased over time. Second, in a direct comparison between export and imports they conclude that the labour intensity of imports was consistently higher and increasing. Based on these observations the authors of this study conclude that the South African economy has no comparative advantage in labour intensive industries. Therefore, it is doubtable that the low-income members of the South African working class, i.e. less-skilled labour, benefited from import liberalisation. This study thus supports partly the theoretical assumptions of the trade model developed in this thesis.

Another study dealing with this subject is Alleyne and Subramanian (2001). Starting with an analysis of the South African trade pattern which yields similar results to those of this thesis, the authors use two different approaches to explain this trade pattern. First, they introduce a factor content approach and explain how by means of this technique a country can be classified as a net exporter of capital and a net importer of labour. Their second approach to test this is called the commodity composition approach. Contrary to the analysis developed in this thesis Alleyne and Subramanian (2001) use an input-output matrix. Moreover,

the study only considers data from 1989 and 1997 and compares these years with each other. Another difference is that the analysis examines the impact of factor content on net trade, i.e. net trade is the dependent variable. Based on the results of this analysis the authors conclude that the South African economy is a net exporter of capital intensive commodities and a net importer of labour. Since this contradicts with the observation that South Africa is relatively well endowed with labour, Alleyne and Subramanian (2001) assumes that the cost of labour with respect to capital is too high. According to the authors this has contributed to a malfunctioning of labour market institutions.

Although Edwards (2001) uses also input-output coefficients, his approach is markedly different from the above study. By means of the input-output decomposition methodology the author assesses the impact of different economic variables on employment change. Due to the structure of the input-output matrix it is possible to distinguish between following variables: final demand, exports, imports and technological change. The effect of these components on employment are analysed with two different sectors as well as two different types of labour. The general conclusion of the author is that exports generated increased employment opportunities that did compensate employment losses due to import penetration between 1993 and 1997. The employment effect of net trade could, however, not reduce unemployment. Moreover, during the same period a structural shift from less-skilled to skilled labour has been observed. As main sources of losses in employment during this period Edwards (2001) defines final demand and especially technological change. This change, however, is defined as the difference between the 1993 version and the 1997 version of the input-output matrix. This is problematic since it is unclear what the effect of trade on technological change is, which is also recognised by the author.

To analyse the impact of trade liberalisation and technological change on factor demand Edwards and Behar (2005) use firm level data of the year 1998. Besides trade related variables and technical efficiency related variables the authors also include relative wages and value added to estimate differences amongst firms with respect to the skilled to less-skilled ratio. With respect to trade variables the estimated function emphasises the importance of tariff rates. Although no dynamic effects are estimated this study yields some interesting results. Another study by Edwards (2005) shows that the relative skill intensiveness of firms increases if firms are

export oriented, are importing a significant share of raw materials and face low tariff rates.

The decomposition approach is also used by Jenkins (2008). Since the author is well aware of general shortcomings of this approach, he adds an econometric estimation of labour demand functions. Whereas the first approach displays a strong impact of productivity growth, which is interpreted as (partial) technology change, the econometric estimation shows that exports and imports did influence labour demand negatively, but that in absolute terms this impact could explain only a small part of decreased labour demand. As a conclusion Jenkins (2008) states that according to the results the negative impact of technology was bigger than the impact of trade on employment.

A recent study that estimates labour functions is Chinembiri (2010). In this paper the author estimates two demand functions which are based on Cobb-Douglas production functions and compares the results for the primary, secondary and tertiary sector with each other. Whereas regression results show now impact of trade variables nor technological change within the tertiary sector, the other estimations report only a negative effect of import penetration. Based on the approach developed by Chinembiri (2010) one could conclude that increased imports did reduce the demand for labour.

The results of these studies are interesting, but do not correspond with the theoretical approach developed in this thesis. They can, however, be used as a benchmark for the less-skilled labour demand function. In the following section the design of the empirical model will be explained.

4.3 Expectations

In this section the insights of the three-dimensional trade model are used to develop a framework that is used to assess the impact of trade liberalisation on the employment of less-skilled labour for the period 1993-2006. Unfortunately, it is not possible to estimate the effect of trade on unemployment directly, since the time period of available observations is to short to yield reliable econometric results. Therefore, the impact of trade on unemployment is testes indirectly. Moreover, the available data are also used to define a labour demand function. It should, however, be noted that this approach is not based on the theoretical insights of the

three-dimensional trade model.

The three-dimensional trade model offers a consistent theoretical framework in which the impact of increased trade can be analysed. However, some restrictions remain. First, the theoretical trade model explains only inter-industry trade, i.e. an industry either exports or imports, but will not export and import at the same time. The descriptive analysis of Chapter 1 showed that this is not the case in any of the South African industries. Therefore, it makes sense to use the absolute value of industry net export as an indicator of trade openness. Industries which are characterised by low values of the Grubel-Lloyd index, i.e. a high level of inter-industry trade, will have thus a higher degree of openness as industries with high values of this index. Second, whereas the theoretical model shows a clear change of input vectors in all industries, the magnitude of this effect on industry level is not clear. Since the panel data are used to estimate the overall effect of trade liberalisation this restriction appears not so important.

Which hypothesis can be deducted from the theoretical model that can also be tested empirically? First, trade openness will decrease the use of capital relative to less-skilled labour in all industries (see Inequality 3.4). Second, trade openness in a framework of a binding minimum wage will increase the share of skilled labour relative to less-skilled labour in all industries (see Inequality 3.5). These hypotheses can be formulated as follows:

$$\frac{v_{Hjt}}{v_{Ljt}} = f_j(|NX_{jt}|)(+) \tag{4.1}$$

$$\frac{v_{Kjt}}{v_{Ljt}} = g_j(|NX_{jt}|)(-) \tag{4.2}$$

Equation 4.1 shows that the fraction of skilled to less-skilled labour in industry j at time t is a positive function of the absolute value of net exports, $|NX_{jt}|$, of this industry j at time t. Equation 4.2 indicates a negative relationship between trade openness and the fraction of capital to less-skilled labour of industry j at time t. The sign indicated next to the $|NX_{jt}|$ function is deducted from the three-dimensional trade model and indicates how trade influences the respective ratio. Moreover, the effect described by Equation 4.1 will be enforced by unemployment, whereas the effect described by 4.2 will be cushioned. Therefore, it is also necessary to include an interaction term between unemployment and $|NX_{jt}|$.

It should also be noted that the theoretical model abstracts from overall economic growth. Therefore, the absolute value of net export shares are used.

The second specification that will be tested is a less-skilled labour demand function. The estimation function is based on the Cobb-Douglas production function. This function estimates the impact of different variables on the demand for less-skilled labour. This approach is similar to Jenkins (2008) and Chinembiri (2010), but extends their approach to three production factors.

The Cobb-Douglas production function can be easily transformed to derive a labour demand function for less-skilled labour. Moreover, due to the nature of the data and the fact that a linear relation will be estimated, logarithmic values are used. The basic of the labour demand function that will be estimated empirically is thus Equation 2.8.1:

$$x_{jt} = B_{jt} v_{Ljt}^{\rho_{Lj}} v_{Hjt}^{\rho_{Hj}} v_{Kjt}^{\rho_{Kj}} \varepsilon_t \tag{4.3}$$

$$logv_{Ljt} = c_0 + c_1 logv_{Hjt} + c_2 logv_{Kjt} + c_3 logx_{jt} + \varepsilon_t \tag{4.4}$$

Note that a time index t is included to the Cobb-Douglas function. The interpretation of the parameters of Equation 4.4 is straightforward. The constant term c_0 captures the technical efficiency of the production process. As discussed by both Jenkins (2008, 67) and Chinembiri (2010, 11) it is very likely that technical efficiency changes over time due to technological changes, which are independent of trade variables. Therefore, it is necessary to include a time trend to the empirical specification of the model. Both c_1 and c_2 capture relative output elasticities. The coefficient corresponding to output captures, as discussed by Jenkins (2008, 67), changes in output which also includes direct effects of imports and exports. The indirect effect of trade flows, i.e. the impact of exports or imports on productivity, can be accounted for by including export and import variables. (Jenkins, 2008, 67) So, although Equation 4.4 forms the basis of the labour demand function, the actual estimated function will be enlarged by adding other control variables.

After discussing the time series which are used for the econometric estimation, the actual form of the estimations will be shown.

4.4 Data

Data series used for econometric estimations have all, except for two, already been discussed in previous chapters. It is, however, important to discuss these data with respect to the estimation purpose of this thesis. Therefore this section explains how data were manipulated to fit both estimation approaches.

With respect to industry output data a new time series is introduced. The RSA Standardised Industry data of Quantec (2007a) contain the time series *Value Added Originating* at the industry level. This time series is consulted on to gain output data in real terms. Trade data on a 6-digit HS level consulted on the website of Trade & Industrial Policy Strategies (2009) are transformed to the industry classification and can be used as export and import data on industry level. The overall nominal GDP data from Statistics South Africa (2009) should also be broken down to industry level, since estimations use export and import shares as trade variables. This transformation was conducted by means of real output shares of these industries. Although this is a rough simplification and does not keep account with different inflation rates amongst industries it is not expected that this will significantly influence estimation results, since it does capture the evolution of exports and imports relatively to output. Data concerning capital and labour use at industry levels were supplied by Quantec (2007a) and Quantec (2007b). What is also new are the unemployment data. These data are retrieved from the World Development Indicators database of the World Bank (2011) and contain overall unemployment rates for the period 1994-2006.

4.5 Estimating the Impact of Trade

As already discussed Equations 4.1, 4.2 and 4.4 are the basis of the empirical models. In the following subsections empiric results are shown and discussed. Estimations are carried out by transforming the basic functions into error correction models (ECM). This transformation allows to capture both short-term and long-term adjustment effects.

4.5.1 Change of input vectors

The functions, described by Equations 4.1 and 4.2, are estimated for the panel data of 31 industries by means of an ordinary least square approach.

Although 35 industries were available it appeared to be necessary to not consider the industry aggregate *gold and uranium ore mining*. Export and import flows for this sector were too volatile and were for specific years also zero. In a second step three industry aggregates were taken out of the empirical analysis. It concerns the *civil engineering and other construction*, the *electricity, gas and steam* and the *other producers* groups. Whereas it can be argued that the latter group consists of miscellaneous products and is therefore difficult to interpret, the former two aggregates do contribute little to South Africa's trade in general and probably distort estimation results, since they produce mainly non-tradable products.

In a first step Equations 4.1 and 4.2 are estimated without taking account of possible interaction with unemployment. The econometric specification of these functions are:

$$\begin{aligned}\Delta\left(log\frac{v_{Hjt}}{v_{Ljt}}\right) &= c_0 + c_1\Delta|NX_{j(t-1)}| + c_2|NX_{j(t-1)}| + \\ &\quad + c_3 log\frac{v_{Hj(t-1)}}{v_{Lj(t-1)}} + c_4\Delta\left(log\frac{v_{Hj(t-1)}}{v_{Lj(t-1)}}\right) + \varepsilon_t \qquad (4.5)\end{aligned}$$

$$\begin{aligned}\Delta\left(log\frac{v_{Kjt}}{v_{Ljt}}\right) &= c_0 + c_1\Delta|NX_{j(t-1)}| + c_2|NX_{j(t-1)}| + \\ &\quad + c_3 log\frac{v_{Kj(t-1)}}{v_{Lj(t-1)}} + c_4\Delta\left(log\frac{v_{Kj(t-1)}}{v_{Lj(t-1)}}\right) + \varepsilon_t \qquad (4.6)\end{aligned}$$

Note that the variable $|NX_{jt}|$ is the absolute value of the difference between the export and the import share of industry j at time t. This approach offers the possibility to account for scale effects due to the increase of the South African economy. Econometric results are displayed in Table 4.1.

The econometric results for the Equations 4.1 and 4.2 displayed in Table 4.1 confirm the hypotheses based on the theoretical model. Whereas the estimated coefficients of the independent variables are displayed next to these variables, the values between brackets are p-values corresponding to the test of significance. Long-run effects are depicted by the logarithmic and lagged variables of Table 4.1, whereas short-run effects are indicated by the Δ-variables. Note that to find the long-run impact of an independent variable on the dependent variable of an ECM the coefficient of the independent variable should be divided by the coefficient of

Variable	$\Delta\left(log\frac{v_{Hjt}}{v_{Ljt}}\right)$	$\Delta\left(log\frac{v_{Kjt}}{v_{Ljt}}\right)$
$\Delta\|NX_{j(t-1)}\|$	-0.000147	0.005189
	(0.0254)	(0.2926)
$\|NX_{j(t-1)}\|$	0.000129	-0.005094
	(0.0623)	(0.1661)
Log Dependent Variable (t-1)	-0.014265	-0.147095
	(0.0000)	(0.0000)
Dependent Variable (t-1)	0.752775	0.829153
	(0.0000)	(0.0000)
Indicators		
R-squared	0.997917	0.757430
Adj. R-squared	0.997628	0.723740
Observations	370	370
Variable	Long-run Effect	
$\|NX\|$	0.009043	-0.034631

Table 4.1: Estimation results for input vectors without unemployment effects

the lagged dependent variable and multiplied by minus one. It is clear to see that increasing trade has a positive and significant effect on the ratio of skilled to less-skilled labour. Although the effect of trade on the ratio of capital to less-skilled labour is not significant at a ten percent level, the sign indicates a negative relationship between these variables. It should be noted that to obtain econometric results two data outliers were eliminated from the estimation. Furthermore, in order to overcome the problem of heteroscedasticity the White cross-section method was used. As already indicated by the variable ε_t industry fixed effects were taken account of, but also time fixed effects were included to the econometric estimation.

In order to capture the effect of unemployment on the change of the input vectors an interaction term is added to Equations 4.5 and 4.6. This interaction term measures the influence of the overall unemployment rate on the adjustment process. The results for these estimations are shown in Table 4.2. The long-run effect of this interaction term is for both specifications positive. With respect to the ratio of skilled to less-skilled labour this result indicates that the positive long-term effect of trade is enforced by high rates of unemployment. Note also that the long run effect of $|NX|$ is now negative, although not significantly. This indi-

Variable	$\Delta\left(log\frac{v_{Hjt}}{v_{Ljt}}\right)$	$\Delta\left(log\frac{v_{Kjt}}{v_{Ljt}}\right)$
$\Delta\|NX_{j(t-1)}\|$	-0.000133	0.005687
	(0.0637)	(0.2598)
$\|NX_{j(t-1)}\|$	-0.000219	-0.014498
	(0.1264)	(0.0241)
$U_{(t-1)} \cdot \|NX_{j(t-1)}\|$	0.000013	0.000328
	(0.0066)	(0.0687)
Log Dependent Variable (t-1)	-0.013887	-0.150556
	(0.0000)	(0.0000)
Dependent Variable (t-1)	0.750228	0.832785
	(0.0000)	(0.0000)
Indicators		
R-squared	0.997934	0.758691
Adj. R-squared	0.997640	0.724325
Observations	370	370
Variable	Long-run Effect	
$\|NX\|$	-0.157701	-0.096296
$U \cdot \|NX\|$	0.000936	0.002179

Table 4.2: Estimation results for input vectors with unemployment effects

cates that in a trade regime without labour market rigidities the ratio of skilled to less-skilled labour would decrease in the wake of trade liberalisation. The interaction term also indicates that high unemployment rates dampen the trade effect on the capital to less-skilled labour input vectors. Without labour market rigidities the effect would be more negative and significant. These results support clearly the predictions of the theoretical model.

4.5.2 Labour demand

Whereas the previous subsection tested two hypotheses based upon the three-dimensional Heckscher-Ohlin trade model, this subsection extents the econometric discussion concerning the effect of trade on the demand for less-skilled labour. The main motivation is the fact that none of the previous studies distinguished between capital, less-skilled labour and skilled labour as three different production factors. This seems, however, a necessary extension of the academic debate. The used model specification is a transformation of the less-skilled labour demand function given

by Equation 4.4 into an ECM specification. This yields:

$$\begin{aligned} logv_{Ljt} &= c_0 + c_1\Delta(logv_{Hj(t-1)}) + c_2\Delta(logv_{Kj(t-1)}) + c_3\Delta(logx_{j(t-1)}) + \\ &+c_4\Delta(logx_{(-j)(t-1)}) + c_5\Delta(logExport_{j(t-1)}) + \\ &+c_6\Delta(logImport_{j(t-1)}) + c_7 logv_{Hj(t-1)} + c_8 logv_{Kj(t-1)} + \\ &+c_9 logx_{j(t-1)} + c_{10} logx_{(-j)(t-1)} + c_{11} logExport_{j(t-1)} + \\ &+c_{12} logImport_{j(t-1)} + c_{13} Trend_t + c_{14} logv_{Lj(t-1)} + \\ &+c_{15}\Delta(logv_{Lj(t-1)}) + \varepsilon_t \end{aligned} \tag{4.7}$$

The dependent variable of Equation 4.7 is this the logarithmic value of less-skilled labour in industry j at time t. All independent variables, except for the trend variable, are lagged by one period. Once again Δ refers to the first difference of the variable. Besides skilled labour input ($v_{Hj(t-1)}$), capital input ($v_{Kj(t-1)}$) and industry output ($x_{j(t-1)}$) Equation 4.7 also includes general demand, defined as the aggregated output of all industries minus the output of industry j ($x_{(-j)(t-1)}$). It makes sense to do this, since it is well known from the input-output analysis theory that sectors are intertwined with each other and that final demand for goods of sector j is also influenced by general demand increase. Moreover, export ($Exportj(t-1)$) and import ($Importj(t-1)$) shares and a trend ($Trend_t$) are also included in the model specification.

The empiric model is estimated with industry fixed effects. Table 4.3 displays empirical results for the estimation of less-skilled labour demand for the data set of 31 industries. Note that values within brackets are p-values corresponding to the test of significance.

Since Δ-variables describe short-run effects within an EMC-model, it is easy to see that according to this estimation no significant short term adjustment effects exist beyond the autocorrelation factor of $\Delta(\log v_{Lj(t-1)})$. Although not all trade variables have a significant impact on the demand for less-skilled labour, estimation results show a significant positive indirect effect of exports. A one percent increase of the exports share of industry j induces an indirect increase in the demand for less-skilled labour of 10.79%. Furthermore, general demand has also a significant positive effect on the demand for less-skilled labour, which is higher than the indirect effect of exports. Trade appears to have no significant direct long-run effect on labour demand. With respect to other studies it is also noteworthy that there is a negative trend observed. This would support

Variable	Coefficient	Prob. t-statistic
$\Delta(\log v_{Hj(t-1)})$	-0.103317	(0.4059)
$\Delta(\log v_{Kj(t-1)})$	-0.024558	(0.3423)
$\Delta(\log x_{j(t-1)})$	-0.004839	(0.7859)
$\Delta(\log x_{(-j)(t-1)})$	-0.014096	(0.9290)
$\Delta(\log Export_{j(t-1)})$	-0.001847	(0.7568)
$\Delta(\log Import_{j(t-1)})$	-0.005315	(0.5878)
$\log v_{Hj(t-1)}$	-0.013674	(0.4269)
$\log v_{Kj(t-1)}$	0.026880	(0.0083)
$\log x_{j(t-1)}$	-0.009442	(0.4498)
$\log x_{(-j)(t-1)}$	0.209140	(0.0621)
$\log Export_{j(t-1)}$	0.011265	(0.0377)
$\log Import_{j(t-1)}$	-0.005315	(0.3810)
$Trend_t$	-0.008014	(0.0252)
$\log v_{Lj(t-1)}$	-0.104440	(0.0000)
$\Delta(\log v_{Lj(t-1)})$	0.936957	(0.0000)
Indicators		
R-squared	0.778952	
Adj. R-squared	0.748439	
Durbin-Watson	1.131791	
Observations	372	
Variable	Long-run Effect	
$\log x_{j(t-1)}$	-0.090406	
$\log x_{(-j)(t-1)}$	2.002489	
$\log Export_{j(t-1)}$	0.107861	
$\log Import_{j(t-1)}$	-0.050890	

Table 4.3: Estimation results for $\log v_{Ljt}$

the conclusion that technological change did decrease the demand for less-skilled labour over time The results of Table 4.3 yield the interesting result that trade induced technological change favours less-skilled labour.

4.6 Conclusion

This chapter started with a literature overview of some studies that addressed the empirical problem to assess the impact of trade on employment in South Africa. Unfortunately, none of these studies uses a trade framework to define an estimation equation. Based on the insights of the theoretical model it is, nonetheless, possible to define a link between

trade and input vectors. Moreover, it is also possible to include the effect of unemployment in this specification. Although the literature review cannot be used to test the theoretical model, it shows that it is also possible to expand the academic discussion in the field of labour demand by including three production factors.

Although it is clear that an econometric analysis does not always yield results which are hundred percent conform with a theoretical model, the estimation results of this chapter support the theoretical trade model. The econometric results support the theoretical expectation that trade liberalisation reduces the capital to less-skilled labour ratio. The sign and magnitude of the interaction term also matches with the theoretical model, i.e. the negative effect of trade is dampened. With respect to the skilled to less-skilled labour ratio a clear positive link with trade is displayed. By including an interaction term it is also possible to show that this impact is enforced by unemployment.

The estimation result for the less-skilled labour demand function shows that exports have a positive indirect effect. Unfortunately the econometric analysis did not yield significant direct trade effects.

Appendix A

South African Standard Industry Classification

Agriculture, forestry & fishing
Coal mining
Gold & uranium ore mining
Other mining
Food
Beverages
Tobacco
Textiles
Wearing apparel
Leather & leather products
Footwear
Wood & wood products
Paper & paper products
Printing & publishing
Coke & refined petroleum
Basic chemicals
Other chemicals
Rubber products
Plastic products
Glass & glass products
Non-metallic minerals
Basic iron & steel
Basic non-ferrous metals
Metal products
Machinery & equipment
Electrical machinery

Communication equipment
Professional & scientific equipment
Motor vehicles, parts & accessories
Other transport equipment
Furniture
Other manufacturing
Electricity, gas & steam
Civil engineering & other construction
Other producers

Appendix B

Descriptive Analysis: Exports

B.1 Overall Export Shares 1993 and 2006

	1993	2006
Basic iron & steel	8.90%	10.61%
Basic non-ferrous metals	23.99%	27.25%
Coal mining	6.99%	5.30%
Other mining	15.79%	9.45%
Machinery & equipment	2.42%	7.42%
Motor vehicles, parts & accessories	3.02%	9.09%

Table B.1: Export shares overall trade for some industries

B.2 Export Shares 1993 and 2006: Trading Partners

	1993	2006
Agriculture, forestry & fishing	9.86%	4.76%
Basic iron & steel	5.90%	11.25%
Basic non-ferrous metals	5.59%	10.89%
Coal mining	12.97%	12.37%
Other mining	13.22%	15.66%
Machinery & equipment	3.20%	12.42%
Motor vehicles, parts & accessories	5.80%	8.77%

Table B.2: Export shares: EU

	1993	2006
Basic chemicals	2.39%	5.58%
Basic iron & steel	10.21%	16.50%
Basic non-ferrous metals	1.01%	8.94%
Coal mining	0.59%	0.00%
Other mining	29.08%	52.21%
Machinery & equipment	0.14%	2.25%
Motor vehicles, parts & accessories	49.57%	0.94%

Table B.3: Export shares: China

	1993	2006
Basic chemicals	10.17%	9.49%
Other chemicals & man-made fibers	5.44%	6.66%
Basic iron & steel	6.55%	7.11%
Basic non-ferrous metals	2.80%	0.93%
Coal mining	0.35%	1.71%
Coke & refined petroleum products	0.85%	10.16%
Food	9.21%	6.80%
Other mining	2.45%	0.86%
Machinery & equipment	11.87%	14.80%
Metal products excluding machinery	3.82%	6.37%
Motor vehicles, parts & accessories	7.53%	6.29%
Paper & paper products	3.30%	2.71%

Table B.4: Export shares: SADC

Appendix C

Descriptive Analysis: Imports

C.1 Overall Import Shares 1993 and 2006

	1993	2006
Basic chemicals	7.41%	4.37%
Other chemicals & man-made fibers	6.11%	4.55%
Other mining	2.48%	15.71%
Machinery & equipment	19.81%	16.10%
Motor vehicles, parts & accessories	12.57%	16.78%
Television, radio & communication equipment	4.03%	5.98%

Table C.1: Import shares overall trade for some industries

C.2 Import Shares 1993 and 2006: Trading Partners

	1993	2006
Basic chemicals	11.06%	5.09%
Other chemicals & man-made fibers	9.22%	7.86%
Electrical machinery & apparatus	4.79%	3.78%
Machinery & equipment	24.02%	21.12%
Motor vehicles, parts & accessories	11.67%	24.67%
Television, radio & communication equipment	3.86%	6.69%
Professional & scientific equipment	4.79%	3.91%

Table C.2: Import shares: EU

	1993	2006
Footwear	14.69%	6.09%
Machinery & equipment	9.00%	25.82%
Metal products excluding machinery	4.46%	3.82%
Television, radio & communication equipment	5.37%	11.21%
Textiles	5.91%	4.21%
Wearing apparel	15.42%	12.58%
Other manufacturing	9.07%	4.97%

Table C.3: Import shares: China

	1993	2006
Agriculture, forestry & fishing	25.79%	7.17%
Basic non-ferrous metals	0.70%	24.02%
Food	8.76%	1.47%
Other mining	20.56%	52.78%
Textiles	5.03%	1.20%
Wearing apparel	3.61%	2.75%

Table C.4: Import shares: SADC

Conclusion

Two general observations with regard to South Africa can be made since the end of the apartheid era. First, its economy became, measured by export and import shares, more integrated in the world economy. In 2006 a considerable share of output was exported, whereas simultaneously the economy relied significantly on imports to supply the demand for inputs and finished products. Second, since 1994 unemployment increased sharply. At the beginning of the new millennium around 30% percent of the South African labour force was unemployed, whereas in 1995 the official unemployment rate was around 15%. Within the 35 industries, which produce tradable products, around 400,000 employment opportunities disappeared in the period 1993-2006. These separate observations led to the research question of this thesis: how did this reintegration influence (un)employment?

To answer this question a consistent theoretical framework was developed. Since it was the aim of this thesis to depict the impact of trade on the demand for labour and on unemployment, a theoretical trade model was developed. In order to design such a trade model it was first necessary to analyse the trade pattern of the South African economy. This descriptive analysis was conducted in Chapter 1 by means of a new analysis process that combined different trade measures. Due to combing a Grubel-Lloyd index, an RCA index and a measurement for marginal intra-industry trade it was possible to classify industries into nine different classes. The result of this classification method displays that the South African trade structure was mainly characterised by inter-industry trade in 1993. In addition, this trade structure did not change substantially between 1993 and 2006. Furthermore, by differentiating between different trading partners and industries it could be shown that South Africa is stuck in the middle between China, which is an emerging developing country, the EU, which is an industrialised economic region and the SADC, which comprises developing countries. About half of South

Africa's exports to the EU and China originate from the mineral and mining industries. Moreover the production of these exports is capital intensive. In addition, a structural change within the auto industry could be observed. Exports of products that are affected by the Motor Industry Development Programme (MIDP) did increase and accounted for roughly 10% of exports in 2006. Exports to the SADC were more diverse and did also contain skilled labour intensive products. Imports from the EU were mainly capital and skilled labour intensive products. Imports from China were mainly less-skilled labour intensive, although the share of these products did decrease over time in favour of more technical products. The SADC was mainly a supplier of primary products and natural resources, which are less-skilled labour and capital intensive products, to the South African economy. These different export and import flows resulted in a high level of inter-industry trade for South Africa. If these trade relations are being simplified and trade with the SADC is ignored it can be stated that South Africa is mainly an exporter of capital and an importer of labour, both less-skilled and skilled.

Based on the insights of the descriptive analysis of the South African trade structure Chapter 2 developed a trade model which analyses this trade flow on a theoretical level. In order to keep this model simple and workable only trade between South Africa, the EU and China is modelled, whereas trade between South Africa and its neighbouring countries, i.e. the SADC, is neglected. Since trade with the EU and China is from a South African perspective characterised by inter-industry trade and the production of exports and imports use different production factors, a Heckscher-Ohlin trade model was developed. Moreover, due to the fact that three countries, three production factors (capital, skilled labour and less-skilled labour) and three different product types are considered a three-dimensional Heckscher-Ohlin trade model was needed. By means of the concepts of the endowment triangle and the triangles of diversification it was possible to discuss trade flows between South Africa, the EU and China. The model showed that due to the fact that in South Africa capital is relatively abundant its economy starts exporting capital intensive products in the wake of trade liberalisation. Moreover, trade liberalisation also induces that overall production in South Africa becomes less capital intensive. However, within the theoretic framework of Chapter 2 unemployment of less-skilled labour was completely neglected. This shortcoming is offset in the following chapter.

Chapter 3 starts with a descriptive analysis of the South African labour market. What happened in 1994 is formally known as a negotiated revolution. It was shown in this chapter that this revolution implied triple transition. Besides a democratic transition there was also a economic and a social transition taking place in South Africa. These transitions influenced the labour market significantly. The decrease of employment within the industries producing tradable sectors was interpreted within this framework and different theoretical explanations were offered. Moreover, the rise of unemployment since 1994 was discussed. Based on the insights of this descriptive analysis it was argued that within a trade framework unemployment could best be explained by means of a binding minimum wage. In the theoretical analysis of Chapter 3 the binding minimum wage is introduced into the three-dimensional Heckscher-Ohlin trade model which was developed in Chapter 2. One implication of the binding minimum wage is that trade liberalisation will have the opposite effect on the change of the skilled to less-skilled labour ratio. Whereas in the trade model without a binding minimum wage less-skilled labour will be used more intensively due to trade liberalisation, increased openness will induce more intensive use of skilled labour with respect to less-skilled labour if the minimum wage is binding. In addition, it was shown that in the wake of trade liberalisation unemployment will increase in South Africa due to the minimum wage. The introduction of the binding minimum wage within the trade framework offers, thus, interesting insights in the link between trade liberalisation and unemployment in South Africa.

In the last chapter the theoretical predictions of the trade model are tested by means of an econometric analysis. A literature overview showed that most papers do not use a consistent trade framework to analyse the impact of trade on (un)employment. Based on the theoretical model it was possible to define two estimation specifications that capture the impact of trade liberalisation on the relative use of capital and skilled labour relative to less-skilled labour. Moreover, the influence of unemployment on these relationships can also be tested. The econometric results supported the predictions of the three-dimensional Heckscher-Ohlin trade model. Although it is not possible to establish a direct link between trade and unemployment, it was shown that unemployment did influence the change of input vectors according to the theoretical model. Besides this extension Chapter 4 also included a discussion of a less-skilled labour demand function. By explicitly keeping account of the fact that three production factors are used in the production of goods it was possible

to show that trade has a significant indirect effect on the demand for less-skilled labour. The approach developed in Chapter 4 extends the existing literature and contribute significantly to the debate on the impact of trade on employment.

To conclude this thesis the insights gathered in the last chapters can be used to discuss some general policy implications. Based on the developed approach it is possible to make policy suggestions with respect to the labour market as well as to the trade regime. According to the theory developed in this thesis unemployment is a result of labour market rigidities. It was argued that these rigidities result into a wage for less-skilled labour that is higher than the market clearing wage defined by the trade model. Therefore, it is logical that labour market policies should try to overcome these distortions. As indicated in Chapter 3 the binding minimum wage for less-skilled labour can only be paid if a part of the less-skilled labour force is unemployed. It would, however, also be possible to change the factor endowment of South Africa, i.e. to induce a relative increase of skilled labour relative to the supply of less-skilled labour. By means of education and training it would be possible to do this. Since transition in 1994 the new South African government did introduce a new educational system and is keen to overcome the educational segregation of the apartheid era. Notwithstanding these efforts, the results are not immediately at hand and benefits can be reaped after a longer time period. In addition, the Skills Development Act of 1998 can also be interpreted as a policy instrument to induce this endowment shift. All in all, the South African government is already active in this policy field. Another approach could aim at reducing the cost of doing business for employers. A simplification of the legal framework could also reduce the cost of employing less-skilled labour and thus decrease unemployment. It is, however, unclear how this suggestion can be implemented without reducing the new gained democratic rights of employees. Another possibility would aim at increasing the quality of the South African infrastructure. This could also induce a reduction of frictions on the labour market and create new job opportunities in different regions. Another policy suggestion would be to increase the support for specific sectors. Chaper 1 showed that industries affected by the Motor Industry Development Programme display a more intra-industry trade pattern. Based on this observation it would thus be possible to support less-skilled labour intensive industries. Although the non-tradable sectors were not discussed in this thesis, it could also be fruitful to support

these industries to absorb unemployed less-skilled labour.

Besides these policy suggestions with respect to the labour market it is also necessary to take a look at the trade policy. In general, this thesis showed that the reintegration of South Africa in the world economy increased unemployment of less-skilled labour. If one assumes that the increased integration displayed in Chapter 1 is the result of trade liberalisation, then it is clear that further trade liberalisation will aggravate the unemployment crisis. If the inter-industry trade pattern of South Africa is the result of an anti-export biased trade regime, it would make sense to restructure this regime in favour of exports. This would probably induce a more intra-industry trade pattern. One of the main aims of the South African trade policy should be a diversification of exports to the EU and China. Whereas the theoretical model cannot predict how this change influences unemployment, the econometric results of the labour demand function would indicate increasing use of less-skilled labour. With respect to the SADC it is clear that South Africa, as the dominant economy within this group, could benefit from further economic integration. This could, however, jeopardise the political functioning of this group in the long run. Therefore, it seems to make more sense for South Africa to promote the economic development of this group alongside with economic integration.

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